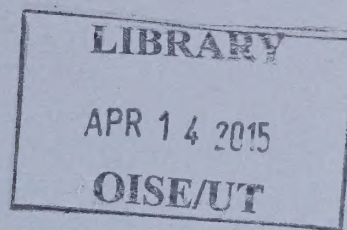


ONTARIO ASSESSMENT INSTRUMENT POOL



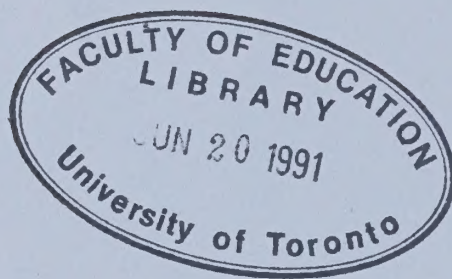
DRAFT

OAC BIOLOGY

UNIT VI

HOMEOSTASIS

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ONTARIO ASSESSMENT INSTRUMENT POOL

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OAC BIOLOGY

UNIT VI

HOMEOSTASIS

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DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control and Homeostasis
 CURRICULAR EMPHASIS: Nature of Science
 KEYWORDS: variables controls

INSTRUMENT CODE: B061AcER.01
 GUIDELINE OBJECTIVE CODE: 61Ac Part 1(3.3a)
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, C.4, D.3
 DIFFICULTY LEVEL: H
 TIME ALLOCATION:

Guideline Objective

Students will be encouraged to develop an appreciation of the fact that most body functions contribute in a co-ordinated fashion to the maintenance of internal stability.

Item Focus

The student should be able to explain why data from investigations of living organisms are difficult to interpret.

Item

The data gathered from observations of living organisms are difficult to interpret. The difficulty in interpretation can often be traced to the ability of organisms to adjust their biological systems so as to minimize the effects of changes. This adjustment is known as *homeostasis*. For example, during vigorous exercise, there is a tendency for a person's temperature to rise dramatically. This is because, in order to support vigorous exercise, the body must increase the amount of energy available to sustain such activities as muscle contraction. However, the body undergoes a number of processes which offset the potential dramatic increase in temperature. For example, the depth of breathing increases. This also influences the heart rate, the blood pressure, the rate of urine production, and a number of other physiological functions.

- A. Suggest three difficulties a researcher could encounter investigating the effect of a change in one of these physiological processes, such as increased urine production.
- B. Researchers in the physical sciences rarely encounter experimental problems as difficult to overcome as those in the biological sciences. Comment on this statement, referring to the paragraph above as an example of a biological problem.

Response/Marking Scheme

- A. When a process such as the production of urine changes, a number of contributing factors could be involved, for example, hormonal changes such as the production of antidiuretic hormone. 1
- Other contributing factors could be increased blood pressure or loss of mineral ions. 1
- These factors could be involved in the homeostatic control of body temperature. 1
- Other physiological changes in response to changes in urine production might have the overall effect of stabilizing body temperature. 1
- This confusion of reactions makes it particularly difficult for the researcher to control experimental values, since the control of one variable can stimulate a change or minimize a change in some other physiological response. 1
- B. In the physical sciences, controlled experiments can usually be set up so that one variable can be isolated and studied. 1
- In physical systems, outside of cybernetic systems, mechanisms similar to homeostasis are not present. 1
- Thus changes that have the effect of minimizing the experimental change do not take place. 1
- However, in living biological systems (as in the example given) changes in one system provoke homeostatic changes in other physiological systems. Thus it is difficult to control variables and to establish cause and effect relationships. 1
- Possible: 9
- Maximum: 6

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control and Homeostasis
 CURRICULAR EMPHASIS: Nature of Science
 KEYWORDS: mechanical model

INSTRUMENT CODE: B061AcSA.01
 GUIDELINE OBJECTIVE CODE: 61Ac Part 1(3.3a)
 INSTRUMENT TYPE: SA
 KLOPPER: A.1, A.3, E.1, E.5
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be encouraged to develop an appreciation of the fact that most body functions contribute in a co-ordinated fashion to the maintenance of internal stability.

Item Focus

The student should be able to state the shortcomings of a mechanical model of a homeostatic system.

Item

The concept of homeostasis has been illustrated through the use of a mechanical model of the control of temperature in a room of a house. Point out one limitation of this mechanical model when it is compared a homeostatic system in a living organism.

Response/Marking Scheme

- | | |
|---|---|
| The mechanical model is not appreciably affected by factors other than heat. | 1 |
| The model usually only regulates in one direction: insufficient heat turns on the system. | 1 |
| A biological system is affected by a number of variables. | 1 |
| As well, a biological homeostatic system affects other systems. | 1 |
| Thus the level of complexity and interconnectedness of a biological homeostatic system is much greater than that of the mechanical model. | 1 |

Possible: 5

Maximum: 4

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Chemical Homeostasis
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS:

INSTRUMENT CODE: B061KaMC.01
 GUIDELINE OBJECTIVE CODE: 61Ka
 INSTRUMENT TYPE: MC
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to identify a definition for chemical homeostasis.

Item

To maintain chemical homeostasis means to

- ☐ A. keep all chemicals within the cell.
- ☐ B. regulate composition within narrow limits.
- ☐ C. keep out toxic chemicals.
- ☐ D. employ carrier molecules to cross membranes.
- ☐ E. exert control over a distant organ.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: homeostasis

INSTRUMENT CODE: B061KaMC.02
 GUIDELINE OBJECTIVE CODE: 61Ka
 INSTRUMENT TYPE: MC
 KLOPFER: A.1, A.2, A.3
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to relate the term homeostasis to its definition.

Item

The term used to describe the ability of a living organism to adjust to changing environmental conditions by regulating their internal processes is

- ☐ A. regulation.
- ☐ B. homeostasis.
- ☐ C. feedback.
- ☐ D. endocrinology.
- ☐ E. behaviour.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological control
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: homeostasis hypertonic hypotonic

INSTRUMENT CODE: B061KaER.01
 GUIDELINE OBJECTIVE CODE: 61Ka
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to describe several mechanisms, both physical and behavioural, that allow multicellular organisms to adapt to environmental conditions, e.g. water and salt balance — marine and freshwater species.

Item

Minor adjustments in structure, function, and behaviour have made possible the adaptation of organisms to a wide range of environments. Describe how the structure and function of the excretory systems and the behaviour of bony fish have allowed them to maintain homeostasis in the following conditions:

- A. A marine fish copes with the problem that its extracellular fluid (ECF) is hypotonic to sea water.
- B. A freshwater fish copes with the problem that its extracellular fluid (ECF) is hypertonic to fresh water.

Response/Marking Scheme

A. By osmosis, the marine fish would lose water from the ECF to the sea, through its gills. By diffusion, it gains sodium ions.	2
Marine fish drink a lot of water.	1
The nephrons have no glomerulus, so that very little water enters the uriniferous tubule.	2
Many capillaries surround the tubule for efficient reabsorption of water.	2
Very little urine is excreted, highly concentrated in urea and salts.	2
Salts are also excreted from the gills.	2
B. By osmosis, water constantly enters the blood through the gills. The scales covering the body limit the surface area through which water can enter. Freshwater fish rarely drink water.	1
They have a large glomerulus in the nephrons, filtering out a large proportion of the water in the blood.	2
There are fewer capillaries surrounding the uriniferous tubules, so little of the water is reabsorbed from the tubule.	2
Salts are reabsorbed from the tubules by active transport.	2
Freshwater fish excrete large quantities of dilute urine.	2
Possible:	22
Maximum:	10

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KaER.02
GUIDELINE OBJECTIVE CODE: 61Ka
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.6, A.10, C.3,
F.1
DIFFICULTY LEVEL: H
TIME ALLOCATION:

KEYWORDS: homeostasis poikilotherm homeotherm

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to explain the difference between homeostasis and the behaviour of seeking an optimal environmental temperature.

Item

A fish seeks out water at its optimum body temperature and remains within it. Compare and contrast this kind of behaviour with homeostasis in a mammal.

Response/Marking Scheme

This behavioural mechanism is not homeostasis because	1
the fish, a poikilotherm, is almost entirely dependent	1
on the environment to maintain its body temperature.	1
In contrast, a mammal (a homeotherm)	1
maintains a relatively constant temperature by homeostasis.	1
The two mechanisms, behaviour and homeostasis, have the same result, of	
achieving optimal temperature for	1
life functions.	1
The mammal requires a higher energy intake, because	1
it constantly loses heat to the environment.	1
The fish operates more efficiently without such energy loss.	1
However, the fish is limited to its restrictive	1
environment, where the mammal can range more widely.	1

Possible: 12

Maximum: 9

DISCIPLINE/SUBJECT: Science/Biology	INSTRUMENT CODE: B061KaER.03
LEVEL: OAC	GUIDELINE OBJECTIVE CODE: 61Ka
UNIT NUMBER: 06	INSTRUMENT TYPE: ER
UNIT NAME: BIOLOGICAL CONTROL & HOMEOSTASIS	KLOPPER: A.1, A.2, A.3, A.7, A.10, C.3, C.4, F.1
TOPIC: Biological Control	DIFFICULTY LEVEL: M
CURRICULAR EMPHASIS: Solid Foundations	TIME ALLOCATION:
KEYWORDS: homeostasis populations	

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to explain how the maintenance of a stable population resembles homeostasis.

Item

When a species is first introduced into a new habitat, its population may increase, but eventually, its numbers come under homeostatic control. Explain how a scientist would determine experimentally that homeostasis occurs in a well-established population.

Response/Marking Scheme

There would be three experimental verifications of homeostasis at work.

- | | |
|---|---|
| 1. A census taken at many separated intervals would show | 1 |
| that numbers (density) in the area remained within narrow limits over | |
| time, | 1 |
| although different individuals were present in different censuses. | 1 |
| 2. If some individuals were artificially removed, | 1 |
| the numbers would increase | 1 |
| back to the census numbers (density). | 1 |
| 3. If additional individuals were artificially introduced | 1 |
| to the area, numbers would decrease | 1 |
| back to the census numbers (density). | 1 |

Possible: 9

Maximum: 6

DISCIPLINE/SUBJECT: Science/Biology	INSTRUMENT CODE: B061KaER.04
LEVEL: OAC	GUIDELINE OBJECTIVE CODE: 61Ka
UNIT NUMBER: 06	INSTRUMENT TYPE: ER
UNIT NAME: HOMEOSTASIS	KLOPPER: A.1, A.2, A.3, A.10, C.2, F.1
TOPIC: Biological Control	DIFFICULTY LEVEL: M
CURRICULAR EMPHASIS: Solid Foundations	TIME ALLOCATION:
KEYWORDS: homeostasis fever	

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to explain the role of fever in maintaining homeostasis.

Item

A person, during a bacterial infection, may experience an increase in body temperature (fever). Although it appears that homeostasis has failed in this case, the phenomenon actually illustrates homeostatic principles. Explain.

Response/Marking Scheme

Although the temperature rises in fever, it normally stabilizes at a higher level.	1
Thus, temperature remains constant but at a higher point.	1
The human's cells can survive such a brief departure from "normal" body temperature	1
but the bacteria lack the homeostatic mechanisms needed to maintain metabolism at elevated temperatures.	1
Thus, the bacteria are prevented from multiplying quickly	1
and can be removed by the body defences.	1
Then, the body thermostat is reset and "normal" body temperature returns.	1

Possible: 7

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology	INSTRUMENT CODE: B061KaER.05
LEVEL: OAC	GUIDELINE OBJECTIVE CODE: 61Ka
UNIT NUMBER: 06	INSTRUMENT TYPE: ER
UNIT NAME: HOMEOSTASIS	KLOPPER: A.1, A.2, A.3, A.8, A.9, A.10, C.2, D.3, F.1
TOPIC: Biological Control	DIFFICULTY LEVEL: M
CURRICULAR EMPHASIS: Solid Foundations	TIME ALLOCATION:
KEYWORDS: homeostasis thermoregulation	

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to explain the relationships of organ systems to the maintenance of homeostasis.

Item

A student holds the bulb of a thermometer in the right hand and plunges the left hand into ice water. It was noted a few minutes after that the temperature recorded by the thermometer decreases. Explain why this response occurs. How can this be considered an example of homeostasis?

Response/Marking Scheme

The drop in temperature of the hand suggests a failure of homeostasis.	1
However, homeostasis operates on the body as a whole.	1
The drop in temperature of the blood was detected by the hypothalamus	1
which through the nervous system	1
brings about vasoconstriction of the peripheral	1
blood vessels, or a shunting of the blood to the deeper vessels,	1
thereby restricting heat loss	1
and minimizing change in the core temperature of the body.	1
Possible:	8
Maximum:	5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KaER.06R
GUIDELINE OBJECTIVE CODE: 61Ka
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.9, A.10, C.2,
C.3, D.3, D.6, F.1
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: homeostasis

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to explain skeletal homeostasis.

Item

Experiments reveal that, at any given time, three to five percent of the adult skeleton is in the early stages of formation. The skeletal mass of a young adult remains constant. Young adults, bed-ridden or placed in orbit for a prolonged period of time, lose some bone mass (osteoporosis).

- A. Explain why it is probable that there is a phenomenon called “skeletal homeostasis”.
- B. What do the facts above tell you about the mechanism of “skeletal homeostasis”?

Response/Marking Scheme

- A. “Skeletal homeostasis” must occur in the young adult because the skeletal mass remains constant 1
- in spite of on-going formation of new bone. 1
- This suggests that on-going bone destruction is also 1
- occurring and rate of formation = rate of destruction 1
- in the healthy young adult.
- B. The stimulus for bone formation must be mass-bearing 1
- under the influence of gravity. 1

Possible: 6

Maximum: 5

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: homeostasis

INSTRUMENT CODE: B061KaSA.01
GUIDELINE OBJECTIVE CODE: 61Ka
INSTRUMENT TYPE: SA
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student will be able to define homeostasis and explain its significance to a state of dynamic equilibrium.

Item

- A. Define homeostasis.
- B. What is the significance of homeostasis to an organism?
- C. Give five examples of substances or conditions for which organisms have homeostatic mechanisms.

Response/Marking Scheme

A. Homeostasis is the maintenance of a steady state	1
(or constant conditions) in the internal environment	1
of an organism within narrow limits.	1
B. A changing environment produces stresses on organisms	1
and cells that might result in death.	1
By carefully regulating their internal environments within narrow limits, organisms maintain optimum conditions for the chemical reactions necessary for	1
the life of the organism.	1
C. Any five examples, such as	5
blood glucose concentration,	
blood pH	
water balance (osmotic pressure)	
ion concentration, e.g., calcium, potassium, sodium	
body temperature	

Possible: 12

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: homeostasis

INSTRUMENT CODE: B061KaSA.02
 GUIDELINE OBJECTIVE CODE: 61Ka
 INSTRUMENT TYPE: SA
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

Guideline Objective

Students will be expected to define homeostasis and explain in general terms why the maintenance of a stable internal environment is so important to living organisms.

Item Focus

The student should be able to define the term “homeostasis”.

Item

Define the term homeostasis.

Response/Marking Scheme

Homeostasis is

the tendency of a system to maintain internal stability	1
within narrow limits	1
through a coordinated response of its parts	1

Possible: 3

Maximum: 3

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Feedback
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: inhibition

INSTRUMENT CODE: B061KbMC.01
 GUIDELINE OBJECTIVE CODE: 61Kb
 INSTRUMENT TYPE: MC
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to identify the mechanisms of homeostasis.

Item

In the metabolic pathway $A \xrightarrow{\text{enzyme a}} B \xrightarrow{\text{enzyme b}} C$ enzyme **a** can bind to its substrate A and also to C. The binding of C to enzyme **a** leads to:

- ☐ A. precursor activation.
- ☐ B. competitive inhibition.
- ☐ C. substrate activation.
- ☐ D. feedback inhibition.
- ☐ E. positive inhibition.

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Feedback Systems
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: positive feedback

INSTRUMENT CODE: B061KbMC.02
 GUIDELINE OBJECTIVE CODE: 61Kb
 INSTRUMENT TYPE: MC
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to identify the end result of the operation of a positive feedback system.

Item



If the system shown above is operating as a positive feedback mechanism, an abnormally high concentration of substance A would

- ☐ A. stimulate the action of enzyme 3.
- ☐ B. inhibit the action of enzyme 3.
- ☐ C. inactivate the whole system.
- ☐ D. have no influence on the action of enzyme 1.
- ☐ E. inhibit the action of enzyme 1.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Feedback Systems
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: negative feedback

INSTRUMENT CODE: B061KbMC.03
 GUIDELINE OBJECTIVE CODE: 61Kb
 INSTRUMENT TYPE: MC
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

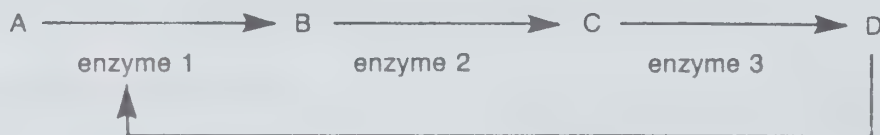
Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to identify the end result of the operation of a negative feedback system.

Item



If the level of substance D in a cell is controlled by the negative feedback loop shown above, the immediate effect of an abnormally high concentration of substance D would be to

- ☐ A. stimulate the conversion of substance A to B.
- ☐ B. inhibit the conversion of substance A to B.
- ☐ C. stimulate the conversion of substance B to C.
- ☐ D. inhibit the conversion of substance B to C.
- ☐ E. inhibit the conversion of substance C to D.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Control Systems
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: receptor

INSTRUMENT CODE: B061KbMC.04
GUIDELINE OBJECTIVE CODE: 61Kb
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to identify the role of a receptor in a biological control system.

Item

In a living organism, a receptor is a specialized cell that

- ☐ A. transmits nerve impulses.
- ☐ B. activates muscle contraction.
- ☐ C. detects stimuli.
- ☐ D. regulates nerve impulses.
- ☐ E. receives impulses from a neuron.

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Control Systems
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: receptor

INSTRUMENT CODE: B061KbMC.05
GUIDELINE OBJECTIVE CODE: 61Kb
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to identify the function of a receptor.

Item

In the nervous system, a receptor is specialized for

- ☐ A. transmitting impulses.
- ☐ B. detecting impulses.
- ☐ C. activating muscles.
- ☐ D. stimulating secretions.
- ☐ E. detecting stimuli.

Response/Marking Scheme

Correct response: E

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Feedback Systems
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KbER.01
GUIDELINE OBJECTIVE CODE: 61Kb
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.8, A.9
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: negative feedback positive feedback

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to explain the significance of a negative feedback mechanism in homeostatic control.

Item

- A. Explain why every homeostatic network must contain at least one point at which negative feedback is operating.
- B. What would happen if only a positive feedback mechanism were operating?

Response/Marking Scheme

- A. At the point of negative feedback, the output varies inversely as the input. 1
This means that the output will continue to fall if the input should begin to rise out of control. 1
Or if the input should begin falling, the output will rise. 1
Thus a set point can be reached and maintained. 1
- B. If, instead, only positive feedback were to operate, a small fluctuation of input would be amplified 1
and result in a precipitous rise or fall of output. 1

Possible: 6

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Biological Control

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: hypothalamus homeostasis

INSTRUMENT CODE: B061KbER.02

GUIDELINE OBJECTIVE CODE: 61Kb

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to explain the role of the hypothalamus in the endocrine system.

Item

The hypothalamus acts as the interface between the nervous system (brain) and the endocrine system (pituitary). Explain how the hypothalamus acts as an interface between the nervous system and the pituitary.

Response/Marking Scheme

It allows sensory stimuli (e.g. temperature) and	1
emotional stimuli (e.g. anxiety)	1
to influence activities controlled by the endocrine glands. In addition, it is the	
site of synthesis of hormones	1
(posterior pituitary, neurohypophysis) or releasing factors (anterior pituitary,	
adenohypophysis). In such	1
cases, it is normally the site of negative feedback	1
where actual regulation of hormone levels takes place.	1

Possible: 6

Maximum: 5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology	INSTRUMENT CODE: B061KbER.03
LEVEL: OAC	GUIDELINE OBJECTIVE CODE: 61Kb
UNIT NUMBER: 06	INSTRUMENT TYPE: ER
UNIT NAME: HOMEOSTASIS	KLOPPER: A.1, A.2, A.3, A.9, E.3, F.2
TOPIC: Biological Control	DIFFICULTY LEVEL: M
CURRICULAR EMPHASIS: Solid Foundations	TIME ALLOCATION:
KEYWORDS: homeostasis thermostat model feedback	

Guideline Objective

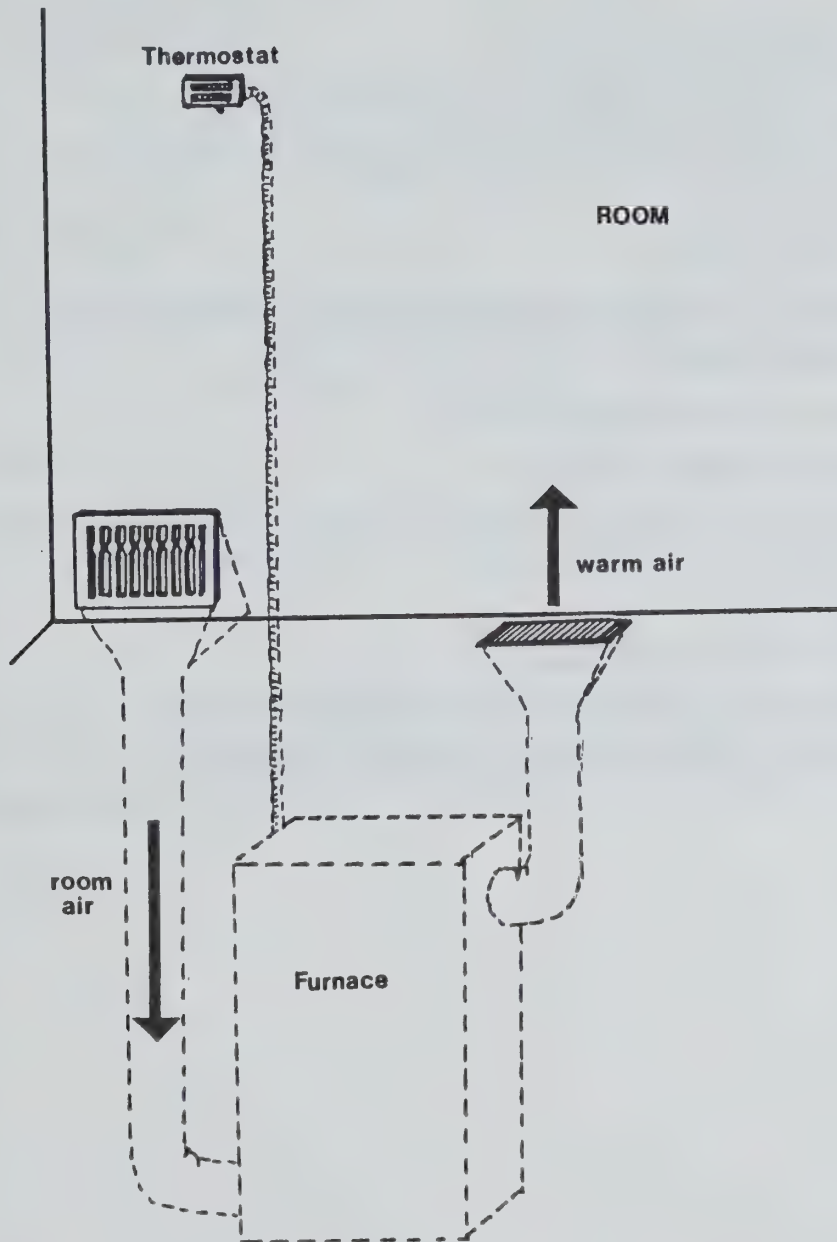
Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to compare the thermostat model with actual homeostatic control.

Item

Refer to Figure 6K.1.



The home thermostat is often offered as an analogy to aid in understanding homeostasis. Evaluate this system as a model of homeostasis, giving both strengths and weaknesses of the model.

Response/Marking Scheme

Note: A diagram may be accepted for partial marks.

Strengths

The model demonstrates feedback in that a	1
portion of the system's output (heat from furnace)	1
affects the receptor as input (activation of the thermostat)	1
The feedback is negative and so can	1
lead to regulation of temperature.	1
Since the more heat that arrives at the input (thermostat) the less heat is	
produced by the effector (furnace).	1
The wires are analogous to blood vessels or nerves	1
in carrying messages from receptor to effector.	1

Weaknesses

This system fails to exhibit the graded response of a biological system	1
being a simple on/off system	1
with a potential to overshoot the set point.	1
In addition, it can respond only to excessive heat loss from the system.	1
If excess heat entered the system, temperature regulation would fail.	1

Possible: 13

Maximum: 10

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KbER.04
 GUIDELINE OBJECTIVE CODE: 61Kb
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, A.7, A.9, A.10.
 C.3, C.4, F.1
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

KEYWORDS: homeostasis endocrine system

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to suggest the design of experiments to establish whether a tissue has an endocrine function.

Item

Upon dissection of a newly discovered organism, *Animalius uniuquus*, a biologist discovered a mass of tissue, which he immediately named the “xenofleisch” and suspected that it was endocrine in nature. What physiological experiments could he perform to establish whether or not the hypothesis was valid?

Response/Marking Scheme

He would first remove the xenofleisch and observe whether	1
or not there was a change in physiology of the organism.	1
If so, he would try transplanting the xenofleisch	1
into a different part of the body having an adequate blood supply.	1
If the original change in physiology did not occur, the xenofleisch is probably endocrine in nature.	1
This would be confirmed by injecting an extract of chemicals from xenofleisch into organisms that had had their xenofleisch removed.	1
If infusion of an extract of the gland into a xenofleischectomized <i>Animalius uniquus</i> led to	1
a restoration of the normal physiology	1
the endocrine hypothesis would be supported further. However, biochemical experiments (isolation of the active component of the extract, discovery of receptors on target cells, etc.) would have to be carried out to establish the hypothesis for certain.	

Possible: 8

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Biological Control

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KbER.05

GUIDELINE OBJECTIVE CODE: 61Kb

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: H

TIME ALLOCATION:

KEYWORDS: homeostasis positive feedback negative feedback

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to explain the meaning and biological significance of positive and negative feedback.

Item

Explain the meaning and biological significance of positive and negative feedback. Include an example of each type of feedback.

Response/Marking Scheme

Feedback exists when a portion of the output of a system	1
returns to the system as input.	1
It is positive if a direct relationship exists between	1
input, and negative if their relationship is inverse.	1
Positive feedback is important in the amplification of messages, but it can lead	
to shut down of systems.	1
For example, hormone greatly diluted in concentration by spreading through-	
out the circulatory system can still have a significant effect upon its target	
tissue.	1
Negative feedback is important in controlling response.	1
For example, if external factors (food) raise the amount of glucose in the blood,	
glycogen synthesis removes glucose from the blood, but if external factors	
(exercise) lower blood glucose, glycogen degradation places more glucose into	
the blood.	1

Possible: 8

Maximum: 6

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Practical Application

INSTRUMENT CODE: B061KbER.06
 GUIDELINE OBJECTIVE CODE: 61Kb
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, A.9, A.10, D.3,
 F.1
 DIFFICULTY LEVEL: H
 TIME ALLOCATION:

KEYWORDS: homeostasis thyroid

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to explain the homeostatic relationships of the thyroid gland in terms of an abnormal condition.

Item

Patients exhibiting primary hypothyroidism have abnormally low concentrations of thyroxine (thyroxine) and abnormally high concentrations of thyrotrophin (TSH) in their blood. In most people TSH and thyroxine are directly (rather than inversely) related. Account for the unusual relationship between blood concentrations of thyroxine and TSH in these patients. In your answer include the role of thyroid releasing factor (TRF).

Response/Marking Scheme

Thyroxin is synthesized and placed into circulation by the thyroid gland in positive response to TSH.	2
TSH is synthesized and released by the pituitary gland	1
in positive response to TRF from the hypothalamus.	2
However, negative feedback exists between thyroxin and TRF.	2
In the patient, the thyroid is probably incapacitated	1
so little thyroxin is secreted and the blood concentration is lower.	2
Low thyroxin concentration stimulates increased output of TRF from the hypothalamus and this, in turn, causes increased secretion of TSH by the pituitary. Since TRF (thus TSH)	1
secretion cannot be slowed through negative feedback from	1
thyroxin, and TSH cannot be cleared from the body by the kidneys as rapidly as it is secreted, the TRF	1
and TSH concentrations in the blood become abnormally high.	

Possible: 14

Maximum: 9

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KbER.07
 GUIDELINE OBJECTIVE CODE: 61Kb
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, A.8, A.10, D.5,
 F.2
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

KEYWORDS: homeostasis buffer pH

Guideline Objective

Students will be expected to explain the concept of a regulatory system using the following terms: stimulus, receptor, regulatory (interpretation) centre, afferent and efferent pathways, effector, response, feedback (positive and negative).

Item Focus

The student should be able to explain the action of buffers in maintenance of homeostasis.

Item

Buffers are chemical systems in which a weak acid coexists with one of its salts. Common biological buffers include carbonic acid/sodium bicarbonate and protein/sodium proteinate. If H^+ ions are removed from such a system, some of the weak acid dissociates, replacing the H^+ ions that were lost. If H^+ ions are added, they can combine with some of the anions (negative ions) of the salt, forming undissociated weak acid. State one reason why such a system should be considered a homeostatic system and one reason why it should not.

Response/Marking Scheme

It is homeostatic in that it resists changes in pH	1
and it is a mechanism that maintains a stable internal	1
environment within narrow limits.	1
It lacks the specialized receptors, afferent and efferent	1
pathways and interpretation or control centre usually	2
considered to be essential parts of homeostasis.	

Possible: 6

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Kidney Function
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: filtrate glomerulus

INSTRUMENT CODE: B061KcMC.02
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the substances that enter the filtrate from the blood.

Item

Under normal conditions in the kidneys, which of the following does NOT enter the filtrate from the glomerulus?

- ☐ A. amino acids
- ☐ B. water soluble vitamins
- ☐ C. minerals
- ☐ D. glucose
- ☐ E. blood proteins

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: nephron active transport water

INSTRUMENT CODE: B061KcMC.03

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify substances carried by active transport from the nephron.

Item

Which of the following does NOT leave the nephron by active transport?

☐

A. potassium ions

☐

B. water

☐

C. calcium ions

☐

D. phosphate ions

☐

E. glucose

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: adaptation homeostasis

INSTRUMENT CODE: B061KcMC.04
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify a problem that environmental conditions create for the organism, and relate it to its homeostatic solution.

Item

The blood and extracellular fluids of a marine fish are hypotonic to sea water. Which of the following is an adaptation of a bony marine fish for coping with the constant flow of water from the blood to the sea?

- ☐ A. They rarely drink water.
- ☐ B. They have large glomeruli in their nephrons.
- ☐ C. They excrete large quantities of dilute urine.
- ☐ D. They lack glomeruli in their nephrons.
- ☐ E. They absorb very little in the uriniferous tubules.

Response/Marking Scheme

Correct response: D

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Kidney Function
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: nephron urine

INSTRUMENT CODE: B061KcMC.05
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the process that begins the formation of urine.

Item

The formation of urine in the mammalian nephron begins with

- ☐ A. active reabsorption.
- ☐ B. countercurrent flow.
- ☐ C. pressure filtration.
- ☐ D. active transport.
- ☐ E. diffusion.

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Kidney Function
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: glomerulus nephron

INSTRUMENT CODE: B061KcMC.06
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the process that occurs in the glomerulus of the mammalian nephron.

Item

Which of the following processes occurs in the glomerulus of the mammalian nephron?

- ☐ A. reabsorption
- ☐ B. filtration
- ☐ C. dilution
- ☐ D. secretion
- ☐ E. active transport

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Kidney Function
CURRICULAR EMPHASIS: Nature of Science
KEYWORDS: urine osmosis

INSTRUMENT CODE: B061KcMC.07
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3.
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the processes involved in filtration and reabsorption in the kidneys.

Item

In a research laboratory, an anaesthetized mouse has a fine tube inserted into one of its ureters. When a small amount of concentrated glucose solution is injected into a vein, the number of drops of urine excreted from the fine tube increases sharply. The best explanation of this phenomenon is that

- ☐ A. glucose in concentrated solution is isotonic to the extracellular fluid.
- ☐ B. a great increase in the amount of plasma increases the rate of formation of urine.
- ☐ C. the amount of glucose in the urine increases if the glucose content of the diet or blood increases.
- ☐ D. urine discharge is naturally intermittent rather than continuous.
- ☐ E. glucose affects osmosis, one of the mechanisms involved in the formation of urine.

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Kidney Function
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: hypertonic loop of Henle

INSTRUMENT CODE: B061KcMC.08
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3.
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the relationship of the filtrate to the extracellular fluid surrounding the uriniferous tubule.

Item

In the loop of Henle, with respect to the extracellular fluid (ECF) surrounding the uriniferous tubule, the filtrate is

☐ A. hypertonic.

☐ B. hypotonic.

☐ C. metatonic.

☐ D. isotonic.

☐ E. mesotonic.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: glomerular filtration nephron

INSTRUMENT CODE: B061KcMC.09

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the source of the energy required for glomerular filtration.

Item

In the nephron, glomerular filtration is achieved by

- ☐ A. active transport of capsule cells.
- ☐ B. blood pressure.
- ☐ C. the loop of Henle.
- ☐ D. a pituitary hormone.
- ☐ E. the collecting tubule.

Response/Marking Scheme

Correct response: B

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: water reabsorption nephron kidney.

INSTRUMENT CODE: B061KcMC.10

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the sites of the reabsorption of water in the mammalian kidney.

Item

The following are parts of the nephron

I proximal convoluted tubule.

II distal convoluted tubule.

III descending branch of the loop of Henle.

IV collecting tubule.

V ascending branch of the loop of Henle.

In which of the above does the reabsorption of water occur?

☐

A. I only

☐

B. I and II only

☐

C. I, II, and III only

☐

D. I, II, III, and IV only

☐

E. I, II, III, and V only

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KcMC.11

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: hypertonic active transport osmotic gradient

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the conditions necessary for the reabsorption of water in the mammalian kidney.

Item

The collecting tubule's reabsorption of water depends on some or all of the following:

- I the presence of a hypertonic interstitial fluid.
- II the presence or absence of antidiuretic hormone.
- III the active transport of water.
- IV an osmotic gradient across the tubule membrane.

Which of the above affect the reabsorption of water?

- ☐ A. I and II only
- ☐ B. III and IV only
- ☐ C. I, II, and IV only
- ☐ D. II, III, and IV only
- ☐ E. I, II, III, and V only

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KcMC.12

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: H

TIME ALLOCATION:

KEYWORDS: countercurrent model loop of Henle active transport kidney

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify the conditions necessary for the reabsorption of water in the mammalian kidney.

Item

The countercurrent multiplier of the loop of Henle in a nephron in the mammalian kidney

I requires active transport, diffusion, and impermeability to certain ions.

II puts sodium ions into a cycle.

III produces a hypertonic interstitial fluid.

IV produces a hypertonic urine in the distal convoluted tubule.

Which of the above is/are involved in the countercurrent multiplier?

- ☐ A. I only
- ☐ B. I and II only
- ☐ C. II, III, and IV only
- ☐ D. II, and III only
- ☐ E. I, II, III, and IV

Response/Marking Scheme

Correct response: C

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KcMC.13

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPFER: A.1, A.2, A.3

DIFFICULTY LEVEL: H

TIME ALLOCATION:

KEYWORDS: loop of Henle nephric filtrate kidney

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify statements about the structure and function of a nephron in a mammalian kidney.

Item

Some or all of the following statements pertain to the structure and function of a mammalian kidney:

- I Blood flows from afferent to efferent arterioles.
- II The nephric filtrate flows from the proximal to the distal convoluted tubules.
- III The ascending and descending branches of the loop of Henle have different permeabilities.
- IV Some nephrons do not have loops of Henle.

Which of the above is/are characteristics of mammalian kidneys?

- ☐ A. I only
- ☐ B. II and III only
- ☐ C. I and IV only
- ☐ D. I, II, and III only
- ☐ E. I, II, III, and IV

Response/Marking Scheme

Correct response: D

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KcMC.14

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.10

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: Bowman's capsule filtrate

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to interpret data related to the functioning of the kidney.

Item

The table shows the results of an experiment on the functioning of a mammalian kidney. The following item is based on an analysis of the data.

SUBSTANCE	IN BOWMAN'S CAPSULE	IN URINE
X	0.1 g/L	0.1 g/L
Y	0.1 g/L	1.0 g/L
Z	0.1 g/L	0.0 g/L

Substance X was likely

- ☐ A. reabsorbed in the tubules.
- ☐ B. not reabsorbed, and not secreted by tubule cells.
- ☐ C. reabsorbed in the tubules and secreted by tubule cells.
- ☐ D. secreted by tubule cells and not filtered through the glomerulus.
- ☐ E. reabsorbed in the tubules, and not secreted by tubule cells.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KcMC.15

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.10

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: Bowman's capsule filtrate

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to interpret data related to the functioning of the kidney.

Item

The table shows the results of an experiment on the functioning of a mammalian kidney. The following item is based on an analysis of the data.

SUBSTANCE	IN BOWMAN'S CAPSULE	IN URINE
X	0.1 g/L	0.1 g/L
Y	0.1 g/L	1.0 g/L
Z	0.1 g/L	0.0 g/L

Substance Y was likely

- ☐ A. reabsorbed in the capsule.
- ☐ B. secreted by the tubule cells.
- ☐ C. not secreted by the tubule cells.
- ☐ D. reabsorbed in the tubules.
- ☐ E. not filtered through the glomerulus.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Nature of Science

KEYWORDS: Bowman's capsule filtrate

INSTRUMENT CODE: B061KcMC.16

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.10

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to interpret data related to the functioning of the kidney.

Item

The table shows the results of an experiment on the functioning of a mammalian kidney. The following item is based on an analysis of the data.

SUBSTANCE	IN BOWMAN'S CAPSULE	IN URINE
X	0.1 g/L	0.1 g/L
Y	0.1 g/L	1.0 g/L
Z	0.1 g/L	0.0 g/L

Substance Z was likely

☐

A. reabsorbed in the tubules.

☐

B. not reabsorbed in the tubules.

☐

C. secreted by the tubule cells.

☐

D. not secreted by the glomerulus.

☐

E. not filtered through the glomerulus.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Feedback Loops

CURRICULAR EMPHASIS: Communication

KEYWORDS: pituitary FSH estrogen

INSTRUMENT CODE: B061KcDL.01

GUIDELINE OBJECTIVE CODE: 61Kc 61Ki

INSTRUMENT TYPE: DL

KLOPPER: A.1, A.2, A.3, A.5, A.11

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

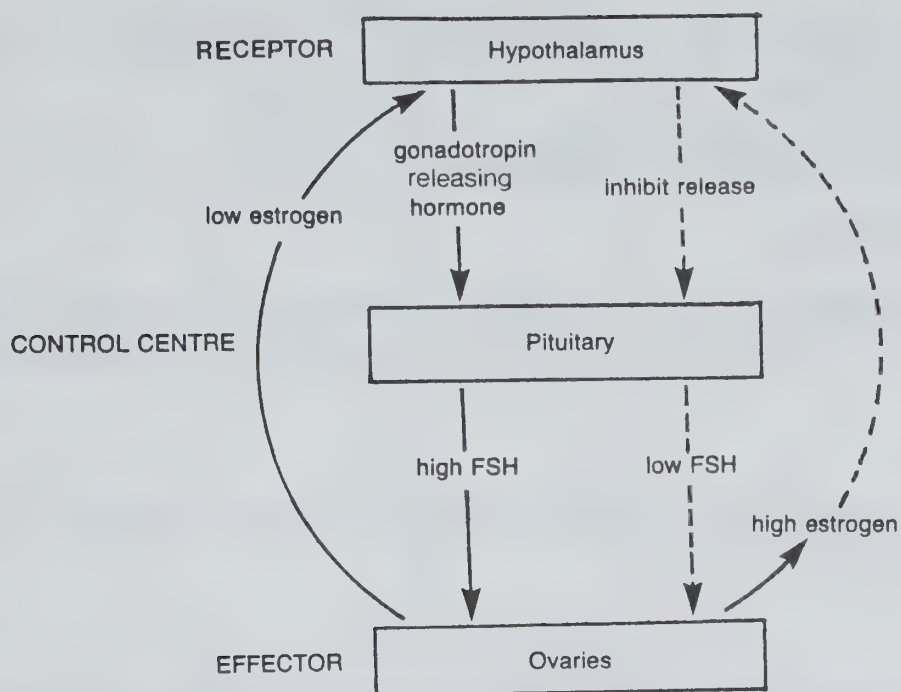
The student should be able to construct diagrams to represent feedback loops that are involved in homeostasis.

Item

The pituitary secretes FSH, which stimulates the ovary to increase its production of estrogen. Then the level of FSH falls.

For the above homeostatic system, construct a labelled diagram to represent the feedback loop involved. On the diagram, indicate the receptor(s), the control centre, and the effector(s).

Response/Marking Scheme



Possible: 9

Maximum: 6

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Feedback Loops

CURRICULAR EMPHASIS: Communication

INSTRUMENT CODE: B061KcDL.02

GUIDELINE OBJECTIVE CODE: 61Kc 61Ki

INSTRUMENT TYPE: DL

KLOPPER: A.1, A.2, A.3, A.5, A.11

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: thermoregulation hypothalamus

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

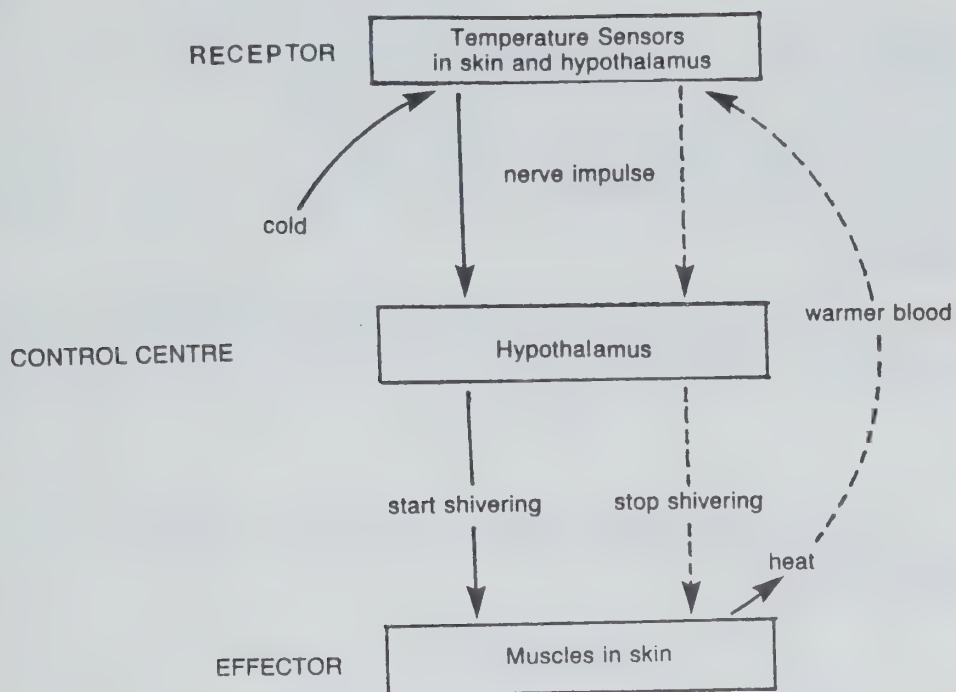
The student should be able to construct diagrams to represent feedback loops that are involved in homeostasis.

Item

You are cold, and you begin to shiver. In a few minutes you feel warmer, and stop shivering.

For the above homeostatic system, construct a labelled diagram to represent the feedback loop involved. On the diagram, indicate the receptor(s), the control centre, and the effector(s).

Response/Marking Scheme



Possible: 10

Maximum: 6

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Feedback Loops

CURRICULAR EMPHASIS: Communication

INSTRUMENT CODE: B061KcDL.03

GUIDELINE OBJECTIVE CODE: 61Kc 61Ki

INSTRUMENT TYPE: DL

KLOPPER: A.1, A.2, A.3, A.5, A.11

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: hypothalamus thermoregulation

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

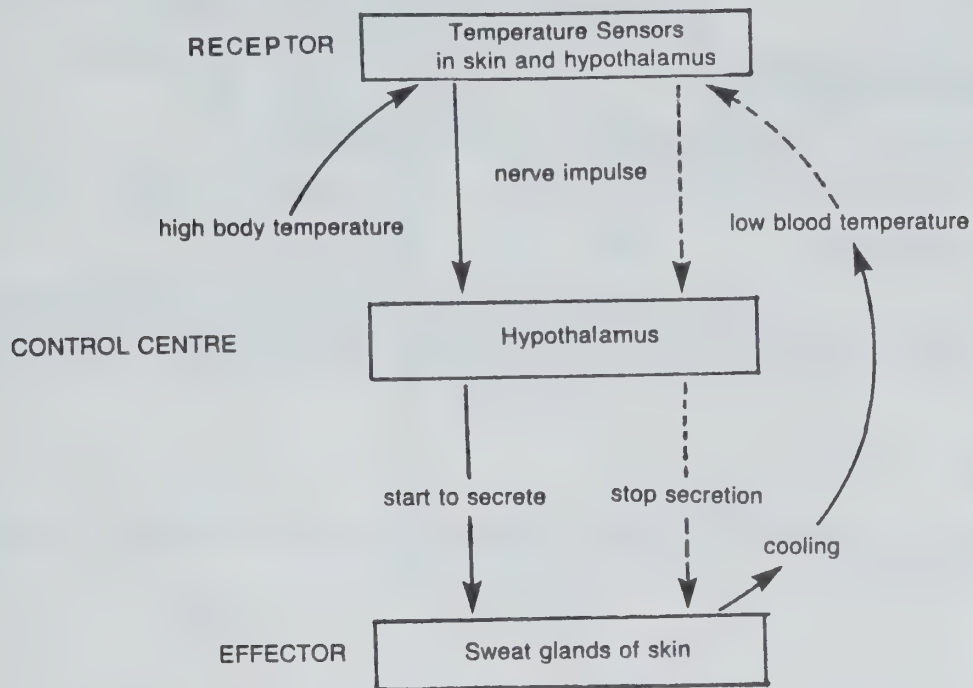
The student should be able to construct diagrams to represent feedback loops that are involved in homeostasis.

Item

You are playing an active game, and you begin to sweat. Soon you feel cooler.

For the above homeostatic system, construct a labelled diagram to represent the feedback loop involved. On the diagram, indicate the receptor(s), the control centre, and the effector(s).

Response/Marking Scheme



Possible: 8

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Feedback Loops
CURRICULAR EMPHASIS: Communication
KEYWORDS: thirst hypothalamus

INSTRUMENT CODE: B061KcDL.04
GUIDELINE OBJECTIVE CODE: 61Kc 61Ki
INSTRUMENT TYPE: DL
KLOPPER: A.1, A.2, A.3, A.5, A.11
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

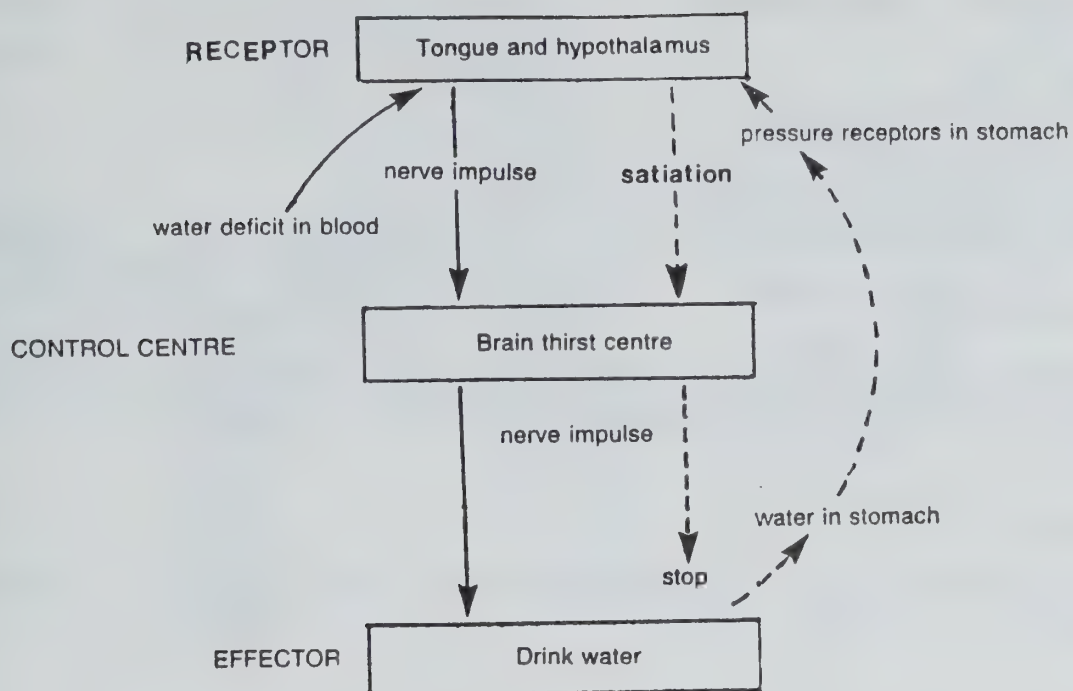
The student should be able to construct diagrams to represent feedback loops that are involved in homeostasis.

Item

You feel thirsty, and drink a glass of cool water. The thirsty feeling disappears.

For the above homeostatic system, construct a labelled diagram to represent the feedback loop involved. On the diagram, indicate the receptor(s), the control centre, and the effector(s).

Response/Marking Scheme



Possible: 9

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nephron Structure
CURRICULAR EMPHASIS: Communication
KEYWORDS: kidney

INSTRUMENT CODE: B061KcDL.05
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: DL
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to draw and label the structure of a nephron and its related blood vessels.

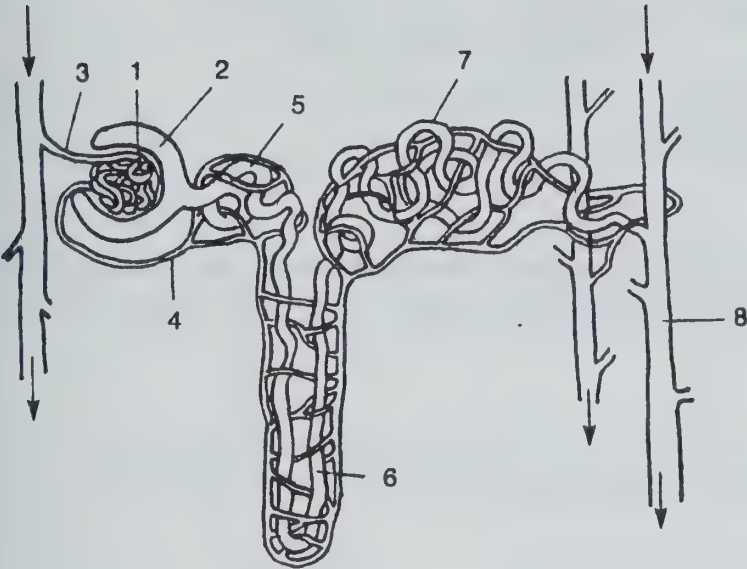
Item

Draw and label a diagram of a nephron. Include the blood supply to the nephron.

Response/Marking Scheme

Drawing
Labels

3



- | | |
|-----------------------|---|
| 1. glomerulus | 1 |
| 2. Bowman's capsule | 1 |
| 3. afferent arteriole | 1 |
| 4. efferent arteriole | 1 |
| 5. proximal tubule | 1 |
| 6. loop of Henle | 1 |
| 7. distal tubule | 1 |
| 8. collecting tubule | 1 |

Possible: 11

Maximum: 8

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Feedback Systems
CURRICULAR EMPHASIS: Communication
KEYWORDS: thermoregulation fever

INSTRUMENT CODE: B061KcER.01R
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: ER
KLOPFER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

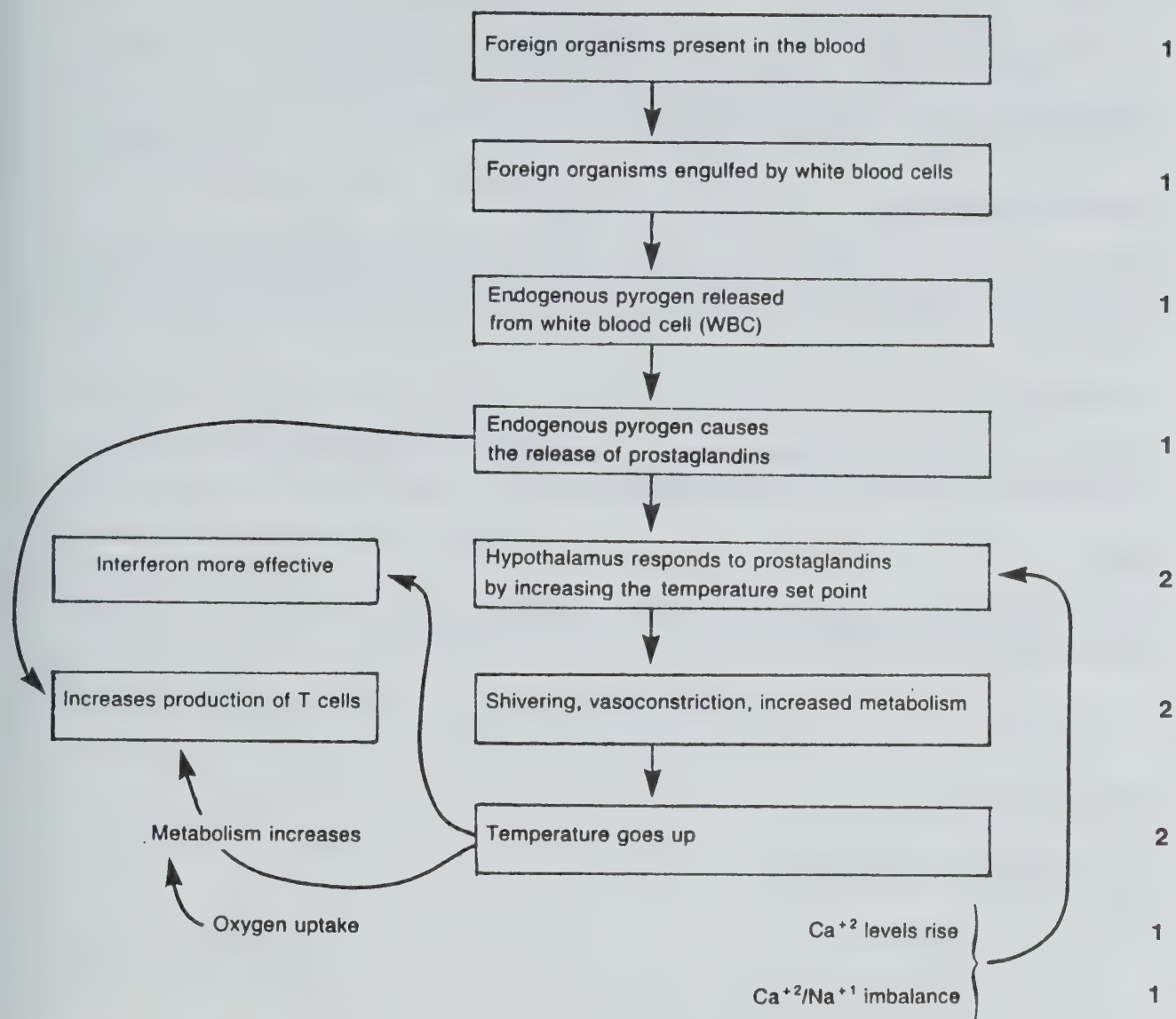
The student should be able to relate the mechanism by which fever plays a role in the immune response.

Item

The raising of body temperature (fever) plays a role in the immune response: fighting infectious disease, as well as providing a resistance to foreign organisms.

Using a flow diagram, outline the events that take place in a homeotherm in eliciting the "fever" response to an infecting organism.

Response/Marking Scheme



Possible: 12

Maximum: 9

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: nephron nitrogenous wastes

INSTRUMENT CODE: B061KcER.02

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3.

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to outline the process of nephron filtration and the necessary conditions for the reabsorption of essential solutes.

Item

Describe the processes by which the human nephron operates to concentrate nitrogenous wastes under the headings

A. filtration,

B. reabsorption,

C. the role of active transport.

Response/Marking Scheme

Filtration:

Blood pressure causes the blood plasma to leave the capillaries in the glomerulus, and enter Bowman's capsule where it enters the uriniferous tubule of the nephron.

Reabsorption:

Water is reabsorbed from the filtrate by osmosis as the filtrate passes along the tubule, especially in the loop of Henle. Here active transport maintains a high concentration of sodium and chloride ions in the extracellular fluid (ECF). The countercurrent mechanism passes sodium and chloride ions from the ascending tubule to the descending tubule, maintaining an osmotic balance in the medulla that forces water to reenter the blood in the capillaries that surround the tubule.

Active transport:

also removes useful components of the filtrate, such as glucose, amino acids, and ions. This leaves nitrogenous waste, urea, with the water needed to carry it out of the body as urine.

Possible: 13

Maximum: 10

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Liver Function
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: blood sugar pancreas

INSTRUMENT CODE: B061KcER.03
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to describe the role of the liver in homeostasis.

Item

Describe the role of the liver and pancreas in regulating blood glucose concentration.

Response/Marking Scheme

Liver cells convert glucose to glycogen, or convert glycogen to glucose.	2
One glycogen molecule consists of many glucose molecules.	1
When the level of glucose in the blood is high,	1
insulin is secreted by the beta cells of the islets of Langerhans of the pancreas.	2
Insulin stimulates liver cells to manufacture glycogen,	1
lowering the blood glucose level.	1
When the level of blood glucose drops too low,	1
alpha cells from the islets of Langerhans secrete	1
glucagon, stimulating the liver cells to convert	1
glycogen into glucose, raising the level of glucose in	2
the blood.	

Possible: 13

Maximum: 10

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Control of Homeostasis
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: kidney function

INSTRUMENT CODE: B061KcER.04R
GUIDELINE OBJECTIVE CODE: 61Kc
INSTRUMENT TYPE: ER
KLOPFER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to describe four ways in which the kidney acts to maintain homeostasis.

Item

List and explain in detail four ways in which the kidney contributes to homeostasis.

Response/Marking Scheme

1. <u>Removal of urea</u>	1
Urea, the product of the metabolism of proteins,	2
leaves the blood during filtration in the glomerulus	2
and only about one-third of it is reabsorbed, so that two-thirds of the urea is excreted in the urine.	1
2. <u>Control of water balance</u>	1
In the left atrium of the heart, stretch receptors secrete a hormone (atrial natriuretic factor) that	1
affects the hypothalamus, inhibiting the release of	1
ADH (antidiuretic hormone, or vasopressin) from the	1
posterior pituitary gland, allowing more water to	1
be excreted in the urine. When blood volume declines, ADH stimulates the cells lining the distal uriniferous	1
tubule and collecting tubule to become more permeable	1
to water and to reabsorb more water from the filtrate.	1;
3. <u>Control of salt balance</u>	1
The distal portion of the uriniferous tubule	1
is under the influence of hormones that control	1
the reabsorption or excretion of several ions.	1
For example, aldosterone from the adrenal cortex controls the reabsorption of sodium. Excess cations such as sodium, potassium, calcium, and magnesium	1
and excess anions, such as chloride, bicarbonate, and phosphate, are excreted in the urine.	1
4. <u>Control of pH</u>	1
Excess hydrogen ions (H^+) from tissue fluids	1
are secreted into the uriniferous tubules.	1
Here some of them combine with ammonia and are excreted as ammonium ions (NH_4^+) in the urine.	2
Other hydrogen ions combine with phosphate ions to form hydrogen phosphate ions (HPO_4^{2-} , $H_2PO_4^-$).	1

Possible: 26

Reference: *Scientific American* . Vol 254:2, 1986 (Feb.)

Maximum: 20

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KcER.05R

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3, A.9, D.1, D.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: Bowman's capsule flow rate ion concentration nephron urea

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to explain why and how various solutes move across the membranes of cells during filtration in a nephron.

Item

Refer to Figure 6K.9 to answer this question.

CONCENTRATIONS OF SOLUTES IN BLOOD AND NEPHRON

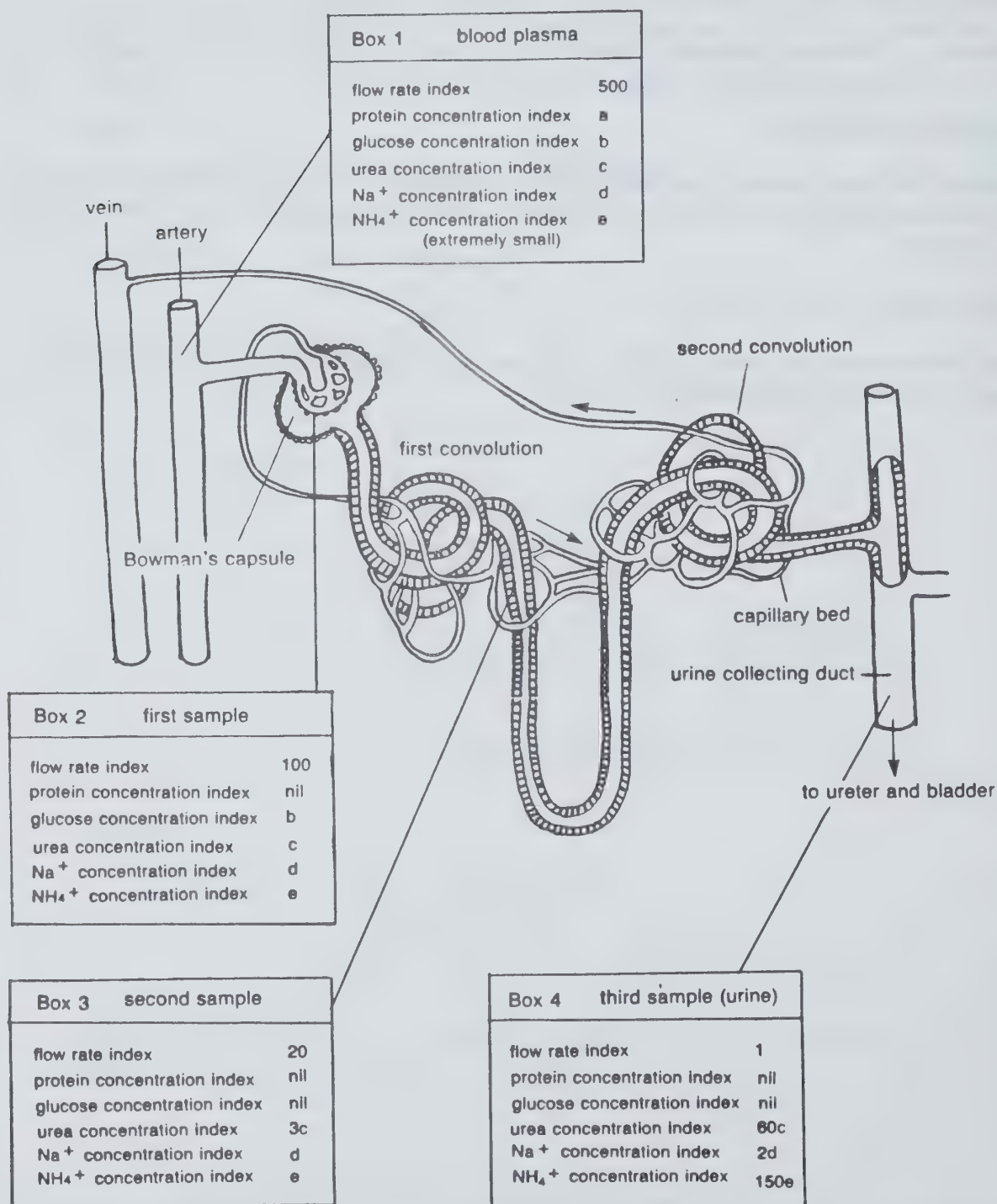


Figure 6K.9 depicts the concentrations of a variety of solutes at a number of points during the formation of urine in a single nephron. The term flow rate refers to the amount of fluid passing a particular point in a given time. In the case of the kidney, most of the fluid is water. The solute concentration indices for the different solutes should be compared with the original concentration in the blood plasma as it enters the nephron. Making use of the above terminology, proceed to answer the following questions.

- A. What is happening to the flow rate index as one moves from the blood plasma sample (Box 1) to the first sample (Box 2)? Account for this observation.
- B. Of the substances listed in the blood plasma (Box 1), which one is not found in Box 2? Explain.
- C. The concentration of the ammonium ion is the same in Box 1 and Box 2. What conclusion can be drawn from this data with respect to the ability of the membrane of the Bowman's capsule to select against the movement of ammonium ions?
- D. Support or refute the following statement:

"If the concentration of a chemical in Box 1 is the same as the concentration in Box 2, this means that there is the same amount of chemical in the two places."
- E. The flow rate in Box 2 is 100 while that in Box 3 is only 20. What percentage of water appears to have passed through the cells lining the Loop and Henle?
- F.
 - i) Using your answer from Part E, what concentration of urea would you expect to find in the sample in Box 3 if there had not been any selective permeability exhibited?
 - ii) Explain why this answer does not agree with the actual amount found in the Box 3 sample.
- G. Note the concentration indices for the ammonium ion in Boxes 3 and 4. Account for what has taken place.

Response/Marking Scheme

- A. The flow rate index is substantially reduced in moving from Box 1 to Box 2. This suggests that the blood entering the glomerulus is under considerable pressure and only a small part of the water and solutes actually pass through the membrane into the Bowman's capsule. 1
1
2
1
1
- B. Protein is present in Box 1 and absent in Box 2. This suggests that either the protein units are too large to pass through the membrane or the membrane is actively selecting against the protein. 1
1
1
- C. Since the ammonium ion concentration is the same in Box 1 and Box 2, this suggests that there has not been any selection taking place with respect to these ions. 1
- D. It does not follow that if the concentrations are the same in two samples at different points that the amounts of chemical would be the same at the two sites. Concentration is simply an expression of the amount of solute per unit volume. If the volumes and the concentrations were the same then there would be the same amount of chemical. 3
- E. Since the flow rate of the liquid (mainly water) is only 20 in Box 3, this suggests that only 20% of the water has passed from Box 2 to Box 3. 2
- F. i) Based on the answer to Part E, I would expect that the concentration of urea in Box 3 would be 'c', if there had not been any selectivity exhibited. 2
- ii) It appears that some form of selectivity was taking place to account for these values. 1

G. If no selectivity were taking place, the concentration of the ammonium ion would be the same in Boxes 3 and 4. The remarkable increase in the concentration of ammonium ions in Box 4 suggests that the ions were selected for, a process which involves active transport and the expenditure of metabolic energy.

3

Possible: 22

Maximum: 18

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: Bowman's capsule filtrate.

INSTRUMENT CODE: B061KcSA.01

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: SA

KLOPFER: A.1, A.2, A.3, A.11

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to identify differences in the concentrations of the components of blood, filtrate and urine.

Item

Complete the following table, comparing the concentrations of the listed materials in three locations in the excretion of urine by the kidneys of a healthy person. Use the symbols, H = high, M = medium, and L = low for the concentrations.

MATERIALS	BLOOD OF THE AFFERENT ARTERIOLE	BOWMAN'S CAPSULE FILTRATE	URINE
blood protein			
glucose			
sodium ions			
urea			

Response/Marking Scheme

MATERIALS	BLOOD OF THE AFFERENT ARTERIOLE	BOWMAN'S CAPSULE FILTRATE	URINE
blood protein	H	L	L
glucose	M	M	L
sodium ions	M	M	L
urea	L	L	H

Possible: 12

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Control of Homeostasis

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KcSA.02

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: water balance extracellular fluid(ECF) intracellular fluid(ICF)

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to account for the homeostatic control of water in the intracellular fluid of a mammal.

Item

- A. What is the significance to an organism of controlling the level of water in its cells?
- B. What cellular processes are involved in the homeostatic control of water within a cell?
How do these processes contribute to the water balance?
- C. In a multicellular organism, water exists in several different “compartments” of the body. Name two of these water “compartments”.

Response/Marking Scheme

- A. Water constantly enters cells from their surroundings, diluting the intracellular fluid. This would affect the biochemistry of the cell since cell solutes function best at particular concentrations. 2
- B. Processes: osmosis, exocytosis (active transport). 2
- Osmosis ensures a constant flow of water into the cell from the extracellular fluid. 1
- Exocytosis (active transport) pumps excess water out of the cell, restoring the correct concentrations in the ICF. 2
- Active transport (Sodium/potassium pumps) control the osmotic pressure of the cell, regulating the intake of water. 2
- C. Two compartments: intracellular fluid (ICF); extracellular fluid (ECF): blood plasma; lymph. 2

Possible: 11

Maximum: 10

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Control of Homeostasis

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: glucose homeostasis

INSTRUMENT CODE: B061KcSA.03

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: SA

KLOPFER: A.1, A.2, A.3, A.5, A.11

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

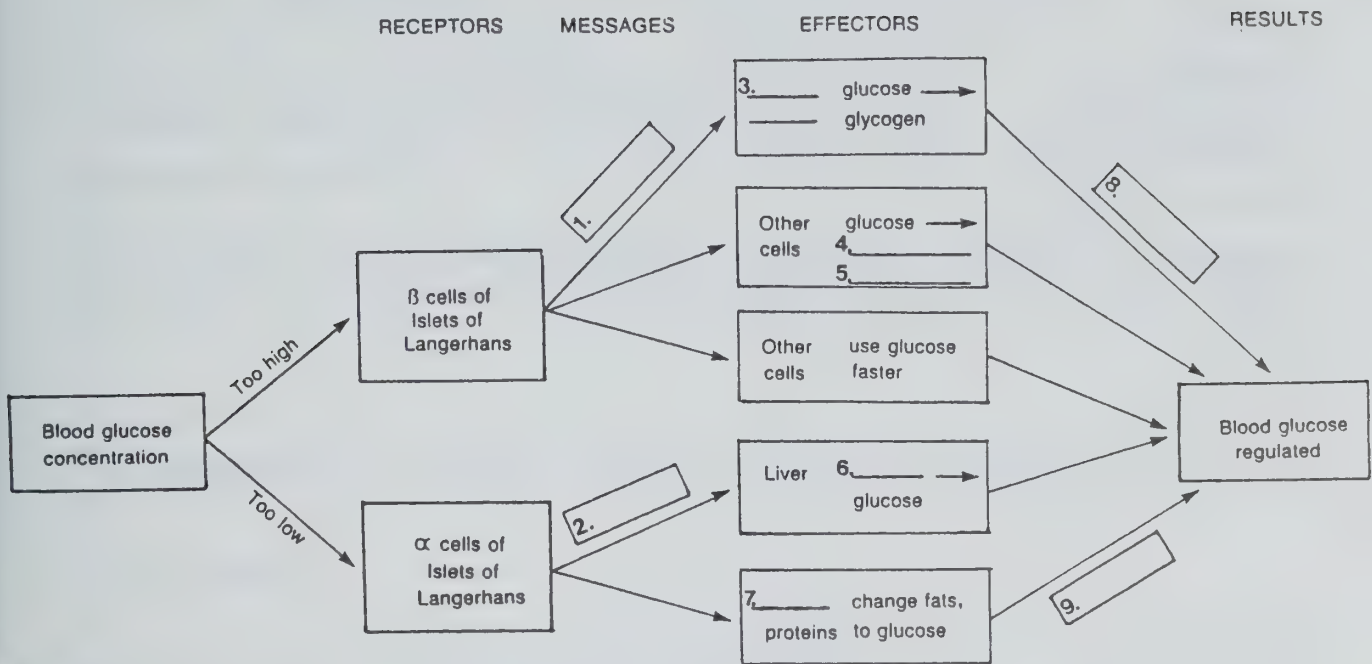
Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to outline the mechanisms of homeostatic control of blood glucose.

Item

Refer to Figure 6K.11.



Complete the numbered blanks in Figure 6K.11 to show the substances and mechanisms involved in the homeostatic control of blood glucose in a mammal.

Response/Marking Scheme

1. insulin
2. glucagon
3. liver (muscles)
4. fats (or proteins)
5. proteins (or fats)
6. glycogen
7. other cells
8. reduced
9. increased

Possible: 9

Maximum: 9

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Structure/Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: cortex medulla renal pelvis

INSTRUMENT CODE: B061KcSA.04

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, A.5

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

Item Focus

The student should be able to state the regions and structures of the kidney, and give their functions.

Item

Complete the following table, showing the three main regions of the human kidney, the structures that occur in each region, and their functions.

REGIONS	STRUCTURES	FUNCTIONS

Response/Marking Scheme

REGIONS	STRUCTURES	FUNCTIONS
Cortex 1	glomeruli, Bowman's capsules capillaries, proximal and distal uriniferous tubules 3	filtration reabsorption 2
Medulla 1	loops of Henle, pyramids of collecting tubules, capillaries 3	regulation of concentrations of water and salts 2
Renal pelvis 1	basin leading to ureter 1	collects urine 1

Possible: 15

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Kidney Structure/Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: nephron uriniferous tubule

INSTRUMENT CODE: B061KcSA.05

GUIDELINE OBJECTIVE CODE: 61Kc

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to list and describe in general terms, including their interactions, the components of any two of the following: nervous system, endocrine system, kidney, blood, liver.

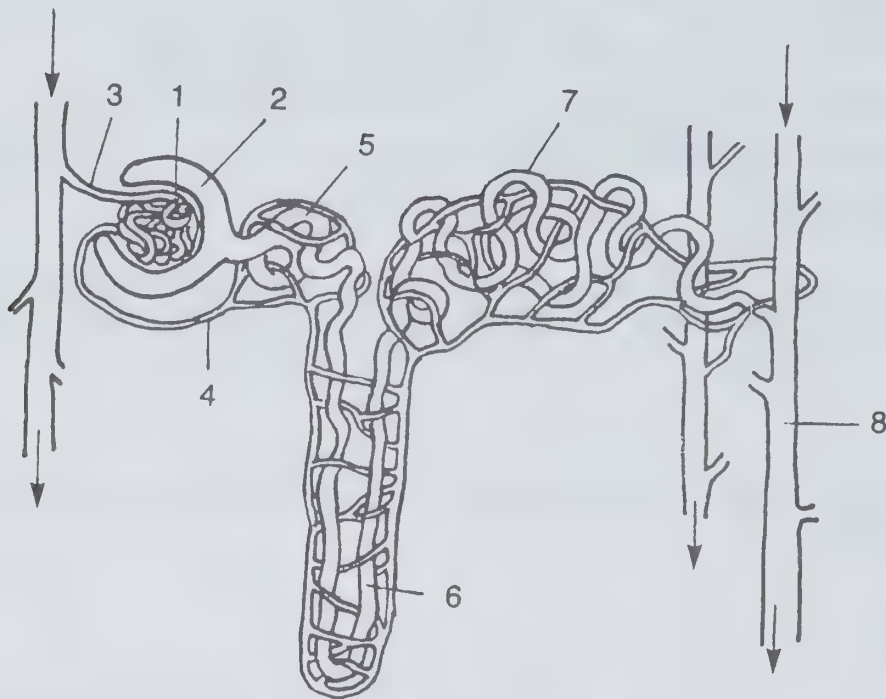
Item Focus

The student should be able to identify the parts of a uriniferous tubule from a diagram, and state their functions.

Item

Refer to Figure 6K.12.

Title: _____



Labels: 1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

- A. Complete the title and labels of Figure 6K.12 in the blanks provided.
- B. Name the fluids found in the structures numbered 2 and 8.
- C. At the part numbered 5, name 3 mechanisms at work to change the composition of the fluid passing through, and give an example of a substance that moves into or out of the fluid by each of the mechanisms.

Response/Marking Scheme

A.

- | | |
|-----------------------------|---|
| 1. glomerulus (capillaries) | 5. proximal tubule (uriniferous tubule) |
| 2. Bowman's capsule | 6. loop of Henle |
| 3. afferent arteriole | 7. distal tubule |
| 4. efferent arteriole | 8. collecting duct |

Title: a nephron. 9

B. #3: (glomerular) filtrate,
#8: urine 2

C.

Mechanisms: (Accept any 3)

hydraulic pressure
(leakage from interstitium)

water, sodium ions

active transport

excess hydrogen ions, glucose, amino acids,
potassium ions

passive diffusion

water, sodium ions, urea, other ions: chlo-
ride, bicarbonate, phosphate

pinocytosis

vitamins, polypeptides

6

Possible: 17

Maximum: 15

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: cerebrum

INSTRUMENT CODE: B061KdMC.01

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify functions of the cerebrum.

Item

All of the following body activities are normally controlled by the cerebrum, EXCEPT

- ☐ A. perception of moving objects in subdued light.
- ☐ B. making a decision.
- ☐ C. learning scientific names and associating them with particular organisms.
- ☐ D. initiating movement of the fingers.
- ☐ E. circulation of blood.

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: co-ordination motor activities.

INSTRUMENT CODE: B061KdMC.02

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify the part of the nervous system that co-ordinates motor activities.

Item

Co-ordination of motor activities in mammals is a function of the

- ☐ A. pons.
- ☐ B. cerebellum.
- ☐ C. cerebrum.
- ☐ D. medulla.
- ☐ E. hypothalamus.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Nervous System
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: brain medulla oblongata

INSTRUMENT CODE: B061KdMC.03
 GUIDELINE OBJECTIVE CODE: 61Kd
 INSTRUMENT TYPE: MC
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify the part of the brain responsible for a particular function.

Item

The part of the brain most directly concerned with the control of the heart beat is the

- ☐ A. cerebellum
- ☐ B. cerebrum
- ☐ C. spinal cord
- ☐ D. medulla oblongata
- ☐ E. solar plexus

Response/Marking Scheme

Correct response: D

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: autonomic nervous system

INSTRUMENT CODE: B061KdMC.04

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: MC

KLOPFER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify specific functions of parts of the nervous system.

Item

The autonomic nervous system controls

☐ A. digestion.☐ B. hearing.☐ C. seeing.☐ D. thinking.☐ E. smelling.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: cerebrum

INSTRUMENT CODE: B061KdMC.05

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: MC

KLOPFER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify the site of the control of several behaviours.

Item

An injury to the cerebrum would most likely interfere with

- ☐ A. breathing.
- ☐ B. swallowing.
- ☐ C. the knee jerk.
- ☐ D. balance.
- ☐ E. the sense of sight.

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nervous System
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: autonomic nervous system

INSTRUMENT CODE: B061KdMC.06
GUIDELINE OBJECTIVE CODE: 61Kd
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify the part of the nervous system involved in a particular behaviour.

Item

The act of blushing when embarrassed is controlled by

- ☐ A. the autonomic nervous system.
- ☐ B. pores in the skin.
- ☐ C. the peripheral nervous system.
- ☐ D. the cerebrum.
- ☐ E. the cerebellum.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KdER.01

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: ER

KLOPPER: A.1., A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: central nervous system peripheral nervous system
autonomic nervous system somatic nervous system

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to briefly describe the structural relationship between, and the role of the major sections of the mammalian nervous system.

Item

Refer to figure 6K.13.

STRUCTURES OF THE MAMMALIAN NERVOUS SYSTEM

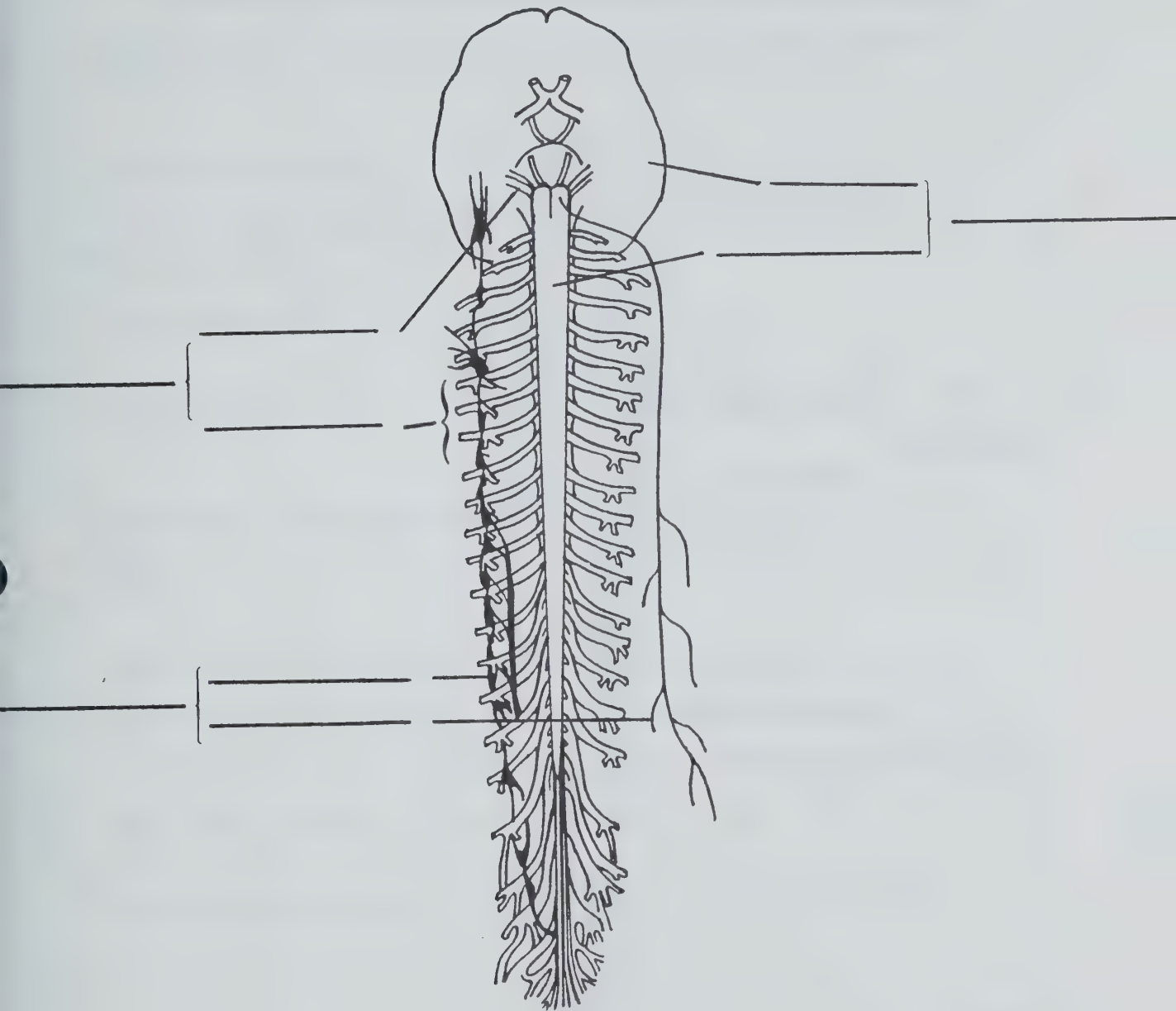


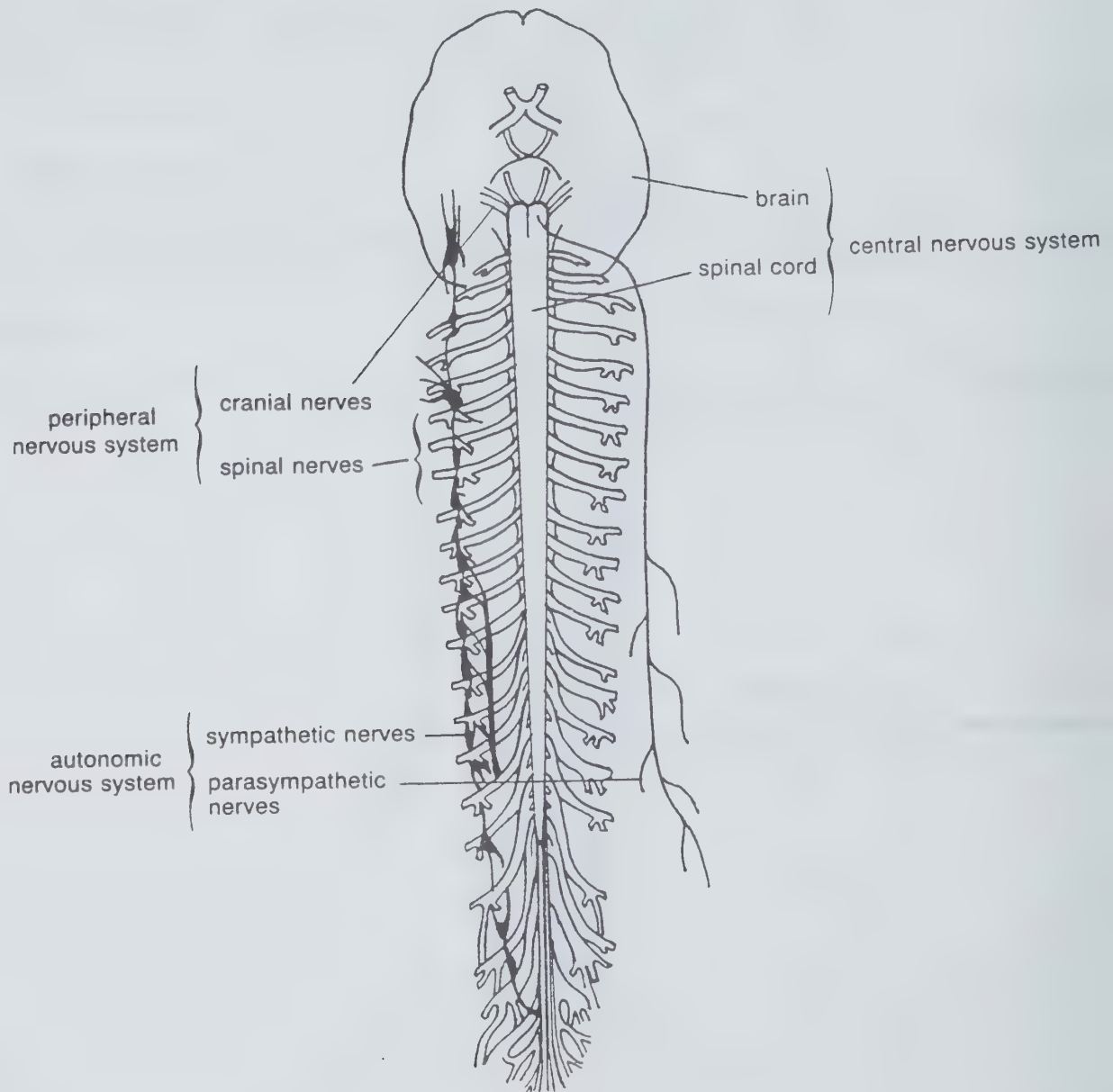
Figure 6K.13 represents the structural components of the nervous system of a mammal: the brain, sympathetic component, sensory nerves, ganglia, autonomic nervous system, cranial nerves, somatic nervous system, motor nerves, parasympathetic component, spinal nerves, peripheral nervous system.

A. Label the diagram.

- B. With the exception of the brain, state the function of each of four components of the mammalian nervous system listed above.

Response/Marking Scheme

STRUCTURES OF THE MAMMALIAN NERVOUS SYSTEM



Labels: $10 \times 1/2 = 5$

B. Accept any four of the following at 2 marks each.

8

Sympathetic component excites an animal to emergency action, and acts in concert with parasympathetic nerves.

Sensory nerves these nerves carry messages from the sense organs to the central nervous system.

Autonomic nervous system - the function over which an animal has very little voluntary control. These would include control over glands and structures made of smooth or cardiac muscle.

Cranial nerves - carry out both sensory and motor functions.

Somatic nervous system - activates the skeletal muscles which move bones and parts of the skin.

Motor nerves - carry messages away from the central nervous system to the glands and muscles. Motor nerves can have excitatory and/or inhibitory effects.

Parasympathetic component - stimulates many of the normal body functions which are involuntary in nature including such things as heart beat, digestion of food, and the regulation of vision.

Spinal nerves - carry out both sensory and motor functions.

Peripheral nervous system - carries out both sensory and motor functions.

Possible: 13

Maximum: 13

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: autonomic nervous system

INSTRUMENT CODE: B061KdER.02

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: ER

KLOPFER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to describe, in general terms, the anatomy and functions of the autonomic nervous system.

Item

Describe, in general terms, the anatomy and functions of the autonomic nervous system.

Response/Marking Scheme

The autonomic system is responsible for actions over which the organism (normally) exerts no conscious control.	1
It influences the actions of glands, for example	1
There are two branches, the sympathetic branch	2
which usually accelerates activity and	1
the parasympathetic branch, which normally slows activity.	2
Anatomically, sympathetic nerves arise from the spinal	1
cord. The ganglia of these nerves are adjacent to the	1
spinal cord, with second ganglia	1
at other points in the body.	1
The parasympathetic nerves originate in the brain and	1
lower spinal cord, and have ganglia on or near the	1
organ(s) involved.	1

Possible: 14

Maximum: 12

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: cerebral cortex

INSTRUMENT CODE: B061KdMA.01

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: MA

KLOPPER: A.1, A.2, A.3, A.6

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify the functions associated with key areas of the cerebral cortex.

Item

Refer to Figure 6K.14.

SURFACE OF THE HUMAN BRAIN



Some of the higher brain functions are associated with definite regions of the cerebral cortex. Figure 6K.14 shows four of these regions identified with letters. Next to each of the letters in the list below, print the number of the associated function (listed in the right column).

REGION

FUNCTION

A. ____

1. auditory (hearing)
2. initiation of motor actions

B ____

3. memory
4. olfactory (smell, taste)

C ____

5. skin sensations
6. speech

D ____

7. visual (sight)

Response/Marking Scheme

Correct responses:

A - 5, B - 2, C - 1, D - 7

Maximum: 4

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KdMA.02

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: MA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: central nervous system peripheral nervous system

autonomic nervous system somatic nervous system

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

Item Focus

The student should be able to identify the structural relationship between, and the role of the major sections of the mammalian nervous system.

Item

From Column B, select the letter of the appropriate term and place the letter in the space provided next to the corresponding function in Column A. Letters from Column B can only be used once.

Column A

1. ____ associated with voluntary muscle regulation
2. ____ stimulates organs and glands in an emergency
3. ____ carries impulses towards the CNS
4. ____ central controlling organ of the CNS
5. ____ regulates normal involuntary functions only

Column B

- A. sympathetic branch
- B. sensory nerves
- C. ganglion
- D. somatic nervous system
- E. peripheral nervous system
- F. parasympathetic component
- G. spinal nerve
- H. brain

Response/Marking Scheme

Correct responses:

1 - D, 2 - A, 3 - B, 4 - H, 5 - E.

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: brain

INSTRUMENT CODE: B061KdSA.01

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: SA

KLOPFER: A.1, A.2, A.3, A.6

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships among, and the role of the components of the nervous system, including the major sections of the brain.

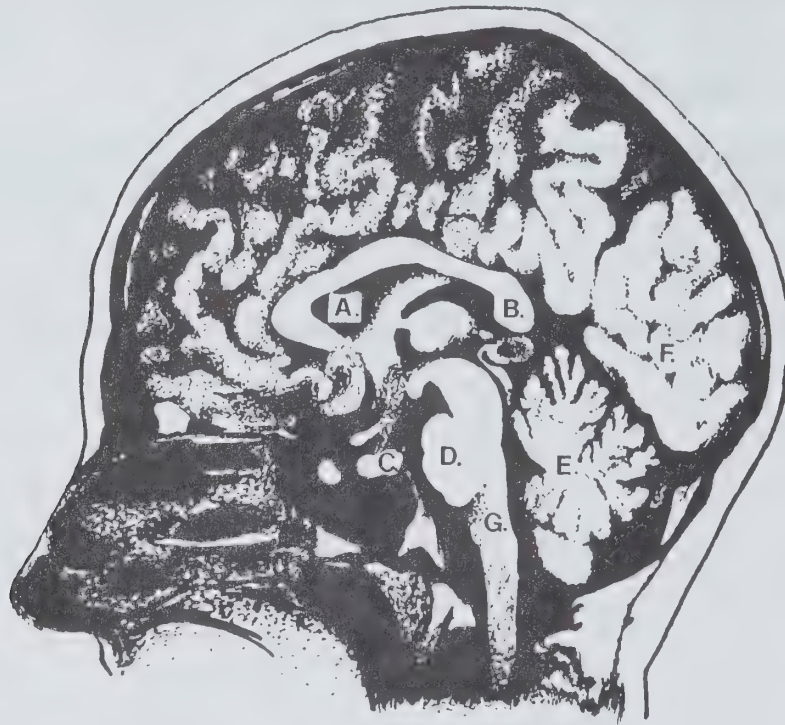
Item Focus

The student should be able to identify the functions of specified parts of the brain.

Item

Refer to Figure 6K.15.

**HUMAN HEAD AS VIEWED USING NUCLEAR
MAGNETIC RESONANCE (NMR)**



from General
Electrical Co.,
as in *American
Scientist*, Vol. 74
No. 1, Jan/Feb '86

Figure 6K.15 is a picture of the inside of a human head, made by a procedure called nuclear magnetic resonance. The procedure allows examination of the interior of the body without cutting into it. Give the name and one major function of each of the 7 labelled structures.

Response/Marking Scheme

A. ventricle	circulation of cerebrospinal fluid	2
B. corpus callosum	carries messages between cerebral hemispheres	2
C. pituitary	secretes hormones	2
D. pons	connects other brain parts	2
E. cerebellum	coordinates motor actions	2
F. cerebrum	logic, creativity, memory	2
G. medulla	controls automatic functions, such as breathing	2

Possible: 14

Maximum: 14

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Structure/Function

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: brain

INSTRUMENT CODE: B061KdSA.02

GUIDELINE OBJECTIVE CODE: 61Kd

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the structural relationships and role of the components of the nervous system including the major sections of the brain.

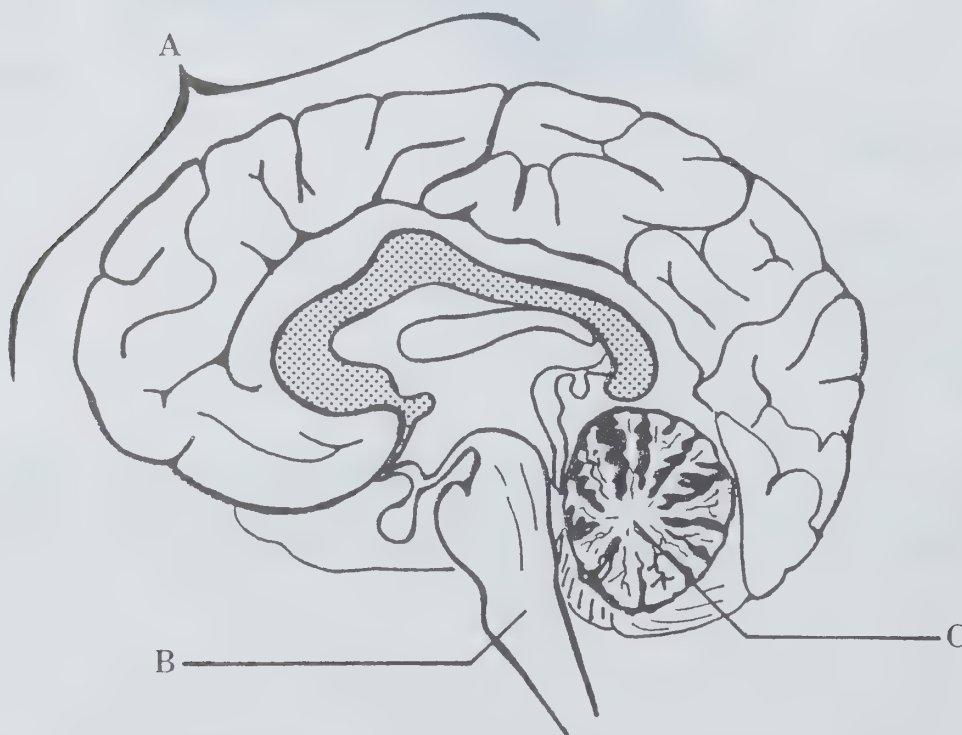
Item Focus

The student should be able to label the principal regions of a mammalian brain.

Item

Refer to Figure 6K.16 to answer this question.

A SIMPLE DIAGRAM OF THE HUMAN BRAIN



Label Figure 6K.16 and give the function of each of the regions labelled.

Response/Marking Scheme

<u>Letter</u>	<u>Name</u>	<u>Function</u>	
A	cerebrum	responsible for sensory and motor control	2
B	medulla	controls autonomic responses such as respiration, and heart rate	2
C	cerebellum	regulates and coordinates muscle contraction	2

Possible: 6

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Reflex Arc

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KeMC.01

GUIDELINE OBJECTIVE CODE: 61Ke

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

KEYWORDS: neuron reflex arc sensory neuron effector receptor

motor neuron

Guideline Objective

Students will be expected to describe the structure and explain the function of a reflex arc.

Item Focus

The student should be able to identify the parts of a reflex arc.

Item

Which is the sequence of neural devices in a reflex arc?

- ☐ A. sensory neuron, receptor, effector, motor neuron.
- ☐ B. effector, motor neuron, sensory neuron, receptor.
- ☐ C. receptor, sensory neuron, motor neuron, effector.
- ☐ D. motor neuron, effector, receptor, sensory neuron.
- ☐ E. receptor, effector, sensory neuron, motor neuron.

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: reflex arc

INSTRUMENT CODE: B061KeER.01

GUIDELINE OBJECTIVE CODE: 61Ke

INSTRUMENT TYPE: ER/DL

KLOPFER: A.1, A.2, A.3, A.4, A.11

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure and explain the function of a reflex arc.

Item Focus

The student should be able to describe the structure and function of a reflex arc.

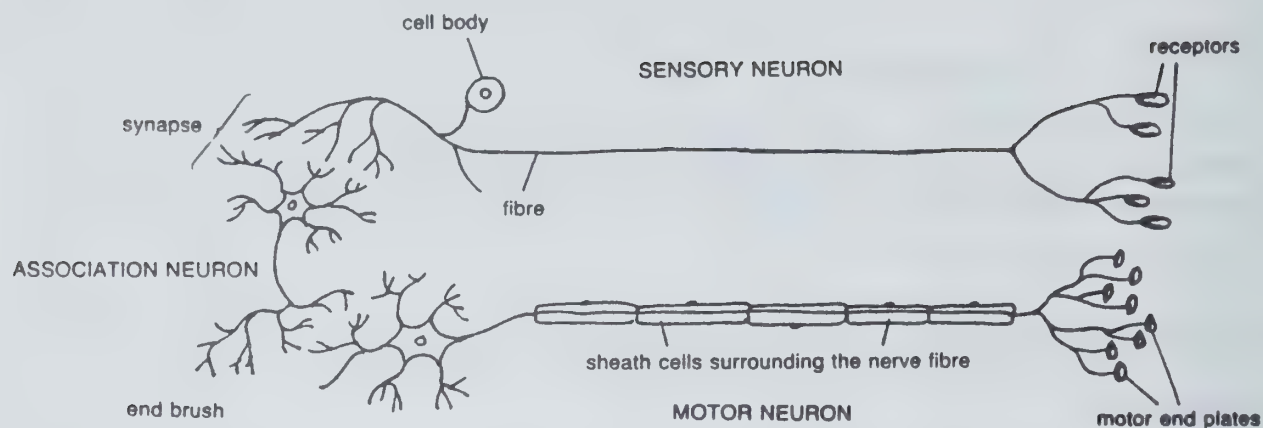
Item

Draw and label a diagram of a reflex arc, and describe its action.

Response/Marking Scheme

Diagram

5



Labels:

- receptor (sense organ)
- sensory neuron
- association neuron (or interneuron)
- motor neuron
- effector (muscle or gland)
- spinal cord

any 5

A stimulus, reaching the receptor,
 initiates a nerve impulse to flow along the sensory neuron
 to a synapse in the spinal cord.
 Here, neurotransmitters are secreted, to
 stimulate association (or inter) neurons to
 initiate a nerve impulse that in turn stimulates the
 appropriate motor neuron
 to effect a rapid, defensive response.
 The motor neuron either causes a muscle to contract,
 or a gland to secrete the appropriate material.

1
1
1
1
1
1
1
1
1

Possible: 20

Maximum: 15

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Reflex Arc
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: behaviour

INSTRUMENT CODE: B061KeSA.01
 GUIDELINE OBJECTIVE CODE: 61Ke
 INSTRUMENT TYPE: SA
 KLOPFER: A.1, A.2, D.3, D.6
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

Guideline Objective

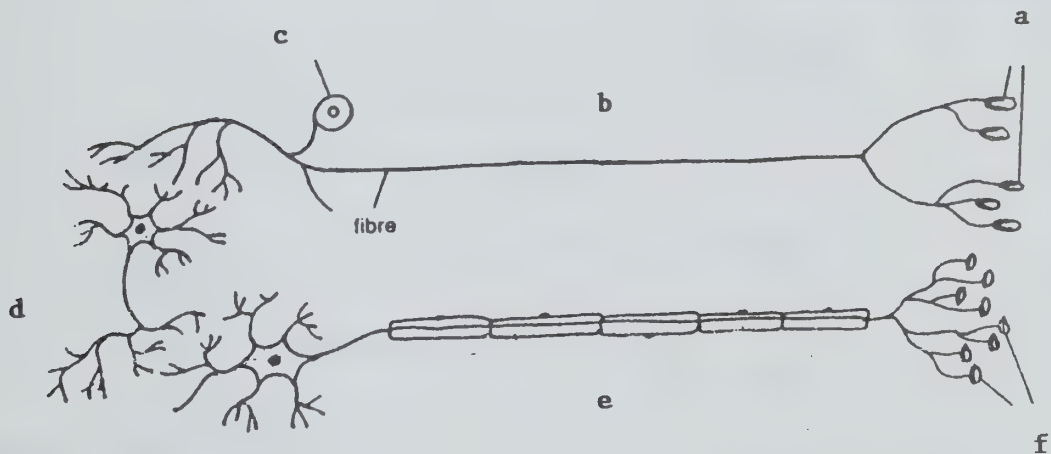
Students will be expected to describe the structure and explain the function of a reflex arc.

Item Focus

The student should be able to label a diagram of a simple reflex arc.

Item

Refer to Figure 6K.17 to answer this question.



- A. Identify the structure shown, and label its parts.
- B. Explain the significance of the structure shown in terms of the behaviour of the organism.

Response/Marking Scheme

A. The structure is a reflex arc.	1
a. receptor	1
b. sensory neuron	1
c. cell body (or dorsal root ganglion)	1
d. association neuron	1
e. motor neuron	1
f. muscle (or effector)	1
B. The reflex arc allows a rapid response to a specific stimulus without taking the time to involve the brain. This may protect the organism where instant reaction may save its life e.g. from a predator.	1

Possible: 10

Maximum: 8

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: neuron

INSTRUMENT CODE: B061KfMC.01

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

Item Focus

The student should be able to identify a feature of the structure of a neuron.

Item

Membranes of nerve axons are specialized to provide

- ☐ A. a resting potential difference resulting in a polarized membrane.
- ☐ B. respiratory enzymes capable of supplying energy rapidly.
- ☐ C. storage places for glycogen molecules.
- ☐ D. electric currents which can travel along the membrane.
- ☐ E. transmitter molecules along their full length.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: neuron

INSTRUMENT CODE: B061KfMC.02

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

Item Focus

The student should be able to identify the nature of the ion concentration in a resting neuron, and during the generation of an action potential.

Item

In a resting neuron, the potassium ions are

- ☐ A. in greater concentration outside the neuron than inside.
- ☐ B. in greater concentration inside the neuron than outside.
- ☐ C. in equal concentration inside and outside.
- ☐ D. not present inside.
- ☐ E. not present outside.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: neuron

INSTRUMENT CODE: B061KfMC.03

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

Item Focus

The student should be able to identify the nature of the ion concentration in a resting neuron, and during the generation of an action potential.

Item

When the neuron generates an action potential, the potassium ions become

- ☐ A. in greater concentration outside the neuron than inside.
- ☐ B. in greater concentration inside the neuron than outside.
- ☐ C. in equal concentration inside and outside.
- ☐ D. not present inside.
- ☐ E. not present outside.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: neuron

INSTRUMENT CODE: B061KfER.01

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

Item Focus

Students should be able to describe the structure and function of the parts of a neuron.

Item

Describe, in words, the structure and functions of the parts of a myelinated mammalian neuron.

Response/Marking Scheme

A typical mammalian neuron consists of a relatively large body which contains the nucleus and other typical	2
cell organelles. Towards one end of the neuron are a	2
number of small branches, called dendrites. These	1
act as receptors of incoming nerve impulses. The	1
dendrites of one neuron are in extremely close proximity to the axon of one to thousands of adjacent neurons.	1
The two neurons are separated by a minute gap called a synapse.	1
Chemicals secreted by axons are called neurotransmitters (e.g., acetylcholine) which initiate a number of chemical acts	1
which enable a nerve impulse to move from the axon of one neuron to the dendrite of another. At the end of the	1
neuron opposite the dendrite(s) is an axon. Nerve	1
impulses are transmitted from the axon of one neuron to the dendrite or cell body of another neuron.	1
A myelin sheath is a tight role of membranes from	1
Schwann cells, insulating the axon from neighbouring neurons and increasing the rate of conduction of a nerve impulse.	2

Possible: 16

Maximum: 12

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Neuron Structure

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: neuron synapse

INSTRUMENT CODE: B061KfSA.01

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, A.10, A.11

DIFFICULTY LEVEL:

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

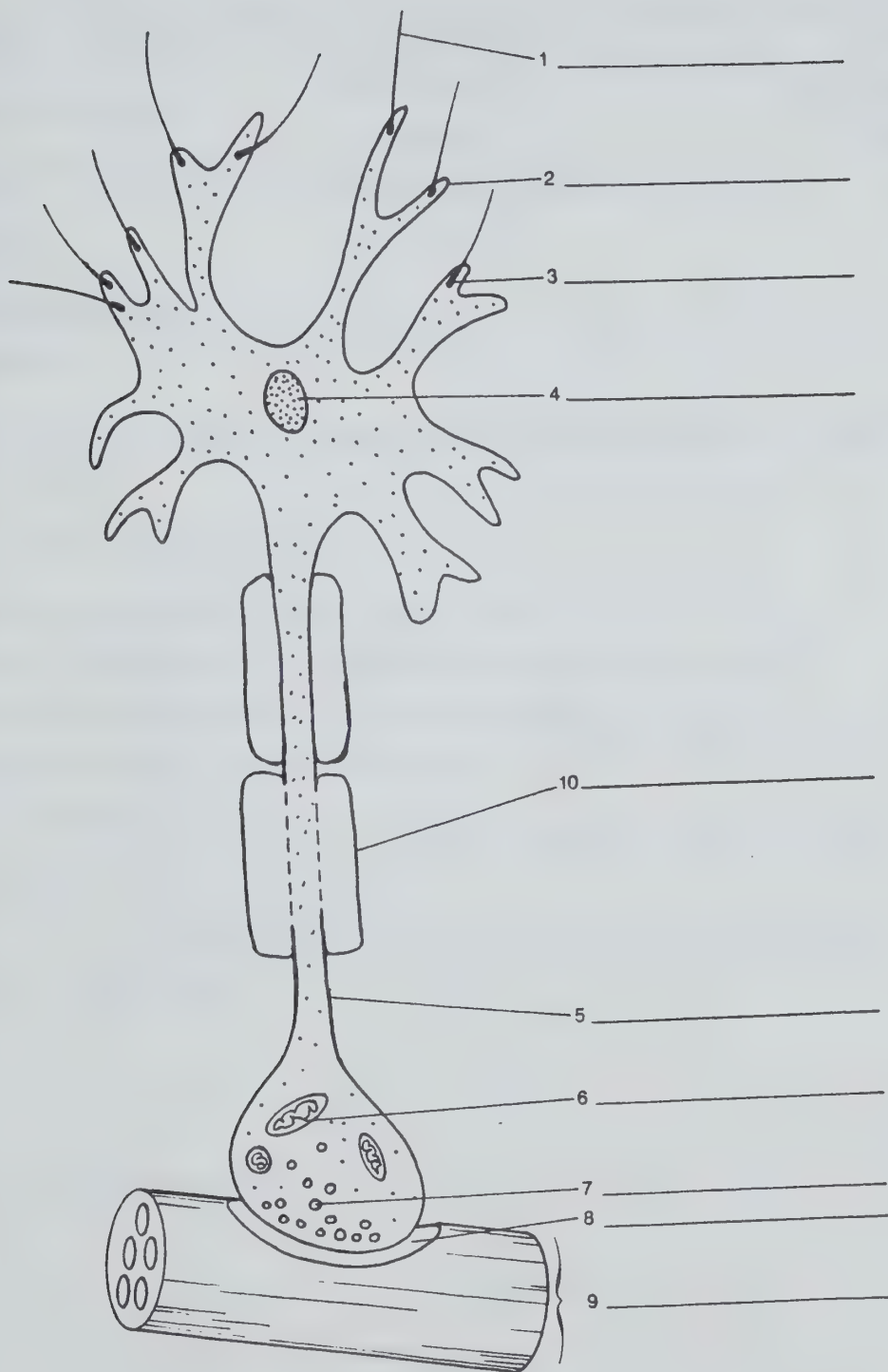
Item Focus

The student should be able to identify and label a diagram of a motor neuron and the chemical changes that conduct impulses across a synapse.

Item

Refer to Figure 6K.18.

TITLE: _____



Provide a title for the diagram in Figure 6K.18, and label each of the numbered blanks.

Response/Marking Scheme

Title: Motor Neuron

1

- | | |
|---------------------------|-------------------------------------|
| 1. axon of another neuron | 6. mitochondrion |
| 2. dendrite | 7. synaptic vesicle |
| 3. synaptic knob | 8. synaptic cleft |
| 4. nucleus | 9. muscle fibre |
| 5. axon | 10. myelin sheath
(Schwann cell) |

Labels: 10 10

Maximum: 11

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Contribution of Scientists

CURRICULAR EMPHASIS: Nature of Science

KEYWORDS: K. Lorenz behaviour imprinting

INSTRUMENT CODE: B061KfSA.02

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

Item Focus

The same as above.

Item

Briefly describe the findings of Konrad Lorenz, and their significance in the development of nervous systems.

Response/Marking Scheme

Konrad Lorenz found that certain species of birds	1
will form a strong attachment to the first slow-moving object they see,	1
as long as this occurs during a certain critical period.	1
The significance of the finding is that there are critical periods in the development of neurons and synapses.	1
The neurons of an organism must develop connections to other neurons if a learning pathway is to be established.	1
There are stages in development when neurons are physiologically prepared to form these connections.	1

Possible: 6

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nerve Impulse

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: Schwann cells synapse

INSTRUMENT CODE: B061KfSA.03

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the structure of a neuron.

Item Focus

The student should be able to describe the role played by the various components involved in the transmission of a nerve impulse.

Item

Describe and state the significance of each of the following with respect to the transmission of a nerve impulse.

A. Schwann cells

B. acetylcholine

C. synapse

Response/Marking Scheme

A. Schwann cells are specialized (glial) cells	1
wrapped around the axon of a neuron, producing the myelin sheath.	2
The myelin sheath permits an increase in the rate of neural transmission.	1
B. Acetylcholine is a neurotransmitter	1
responsible for transmitting an action potential over a synaptic cleft.	2
C. Synapse is the area of close contact between the	1
axon terminal of one neuron and the structure that it stimulates. The	
synapse allows control over the	1
order and direction of action potentials.	2

Possible: 11

Maximum: 10

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Neurons

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: motor neuron sensory neuron

INSTRUMENT CODE: B061KfSA.04

GUIDELINE OBJECTIVE CODE: 61Kf

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, A.11

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

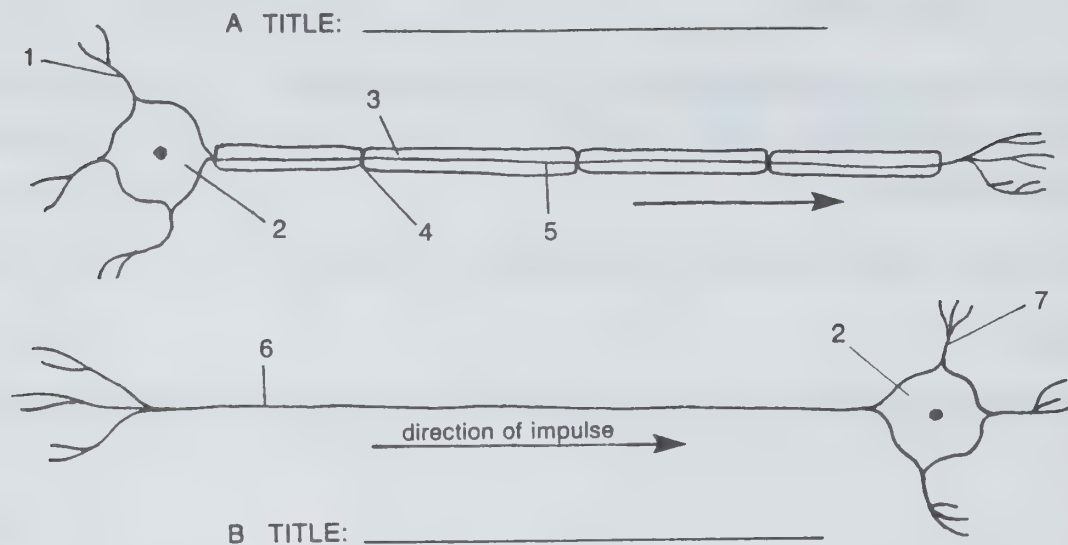
Students will be expected to describe the structure of a neuron.

Item Focus

The student should be able to identify diagrams of sensory and motor neurons, identify their parts, and state their locations and functions.

Item

Refer to figure 6K.19.



A. Write the titles of each of the diagrams in the spaces provided.

B. In the following spaces, print the labels for each of the numbered parts.

- | | |
|----------|----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |
| 5. _____ | 6. _____ |
| 7. _____ | |

C. State the location in the nervous system of the parts labelled 2 in each diagram.

D. State the function of each of the types of cell.

Response/Marking Scheme

A. Diagram A: motor neuron	1
Diagram B: sensory neuron	1
B. Labels:	7
1. dendrite (dendrite fibre)	
2. cell body	
3. myelin sheath	
4. node of Ranvier	
5. axon (axon fibre)	
6. dendrite	
7. axon	
C. Motor neuron: cell body located in the grey matter of the spinal cord.	1
Sensory neuron: cell body is in a dorsal root ganglion of the spinal cord.	1
D. Motor neuron: transmits impulses from the central nervous system to effector organs (muscles, glands).	1
Sensory neuron: transmits impulses from sensory receptors to the central nervous system.	1
Possible:	13
Maximum:	13

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nerve Fibre
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KgER.01
GUIDELINE OBJECTIVE CODE: 61Kg
INSTRUMENT TYPE: ER
KLOPFER: A.1, A.2, A.3, A.9
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: neuron resting potential

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

Same as above.

Item

Describe and explain the condition of a resting nerve fibre (i.e., one which does not have an impulse travelling along it).

Response/Marking Scheme

The interior of a resting fibre is negatively charged with respect to the exterior.	1
The difference, called the resting potential	1
is approximately -70 mV.	1
ATP supplies the energy to maintain resting potential.	1
Sodium ions are actively transported from the	2
interior of the fibre into the extracellular fluid;	1
making the concentration greater in the ECF.	1
Potassium ions are actively transported from	2
the ECF into the neuron; making its concentration	1
greater inside than in the ECF.	1
There is a tendency for potassium ions to diffuse out and for sodium ions to	
diffuse in.	1
Negatively charged chloride ions are also quite mobile, diffusing readily through	
the membrane.	1
The sodium ions are pumped out as fast as they diffuse in, but potassium ions	
are held by negatively-charged proteins, leaving a surplus of negative chloride	
ions	2
in the interior of the neuron, creating the negative resting potential.	1

Possible: 17

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Nerve Impulse
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: neuron

INSTRUMENT CODE: B061KgER.02
 GUIDELINE OBJECTIVE CODE: 61Kf
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, A.9
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

Same as above.

Item

Explain the changes that occur along the nerve fibre during the transmission of a nerve impulse.

Response/Marking Scheme

A stimulus increases the permeability of the membrane to sodium ions, which diffuse faster into the neuron	1
changing the electrical potential.	1
A weak stimulus does not permit enough sodium ions to enter to reach the threshold level, and the resting potential is re-established.	2
A strong stimulus allows enough sodium ions to enter to raise the potential to -50 mV, causing a rapid influx of sodium ions, eliminating the resting potential.	2
Temporarily, the interior of the neuron becomes positively charged.	1
This depolarizing action spreads along the nerve fibre, increasing the permeability of the membrane to sodium ions in each adjacent part.	2
The wave of depolarization is a nerve impulse (or action potential).	1

Possible: 10

Maximum: 7

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Nerve Impulse
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: synapse

INSTRUMENT CODE: B061KgER.03
 GUIDELINE OBJECTIVE CODE: 61Kg
 INSTRUMENT TYPE: ER
 KLOPFER: A.1, A.2, A.3, A.9
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

Same as above.

Item

- A. What is a synapse?
- B. Explain how a nerve impulse crosses a synapse.

Response/Marking Scheme

- A. The synapse is a small gap between the synaptic knob at the end of an axon and the post synaptic dendrite, or cell body. 2
- B. When an impulse reaches a synaptic knob, it causes the release of a synaptic transmitter substance, 1
 - such as acetylcholine, noradrenalin, dopamine. 1
 - This transmitter attaches to a receptor site and alters the permeability of the membrane of the 1
 - post synaptic dendrite to sodium ions. 1
 - Sodium ions diffuse into the post-synaptic neuron, causing depolarization, which on reaching threshold value triggers an action potential. 2

Possible: 8

Maximum: 6

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nervous System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: neuron threshold

INSTRUMENT CODE: B061KgMC.01

GUIDELINE OBJECTIVE CODE: 61Kg

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to identify how nerve impulses travel along a neuron.

Item

When a stimulus reaches its threshold value in a neuron

- ☐ A. Na^+ ions rush out of the neuron.
- ☐ B. K^+ ions rush into the neuron.
- ☐ C. Cl^- ions rush out of the neuron.
- ☐ D. Cl^- ions rush into the neuron.
- ☐ E. the membrane of the neuron is depolarized by ion flow.

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nervous system
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: action potential

INSTRUMENT CODE: B061KgMC.02
GUIDELINE OBJECTIVE CODE: 61Kg
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to identify the process involved in creating an action potential in a nerve cell.

Item

The action potential in a nerve is initiated by

- ☐ A. an influx of sodium ions across the neural membrane.
- ☐ B. an influx of potassium ions across the neural membrane.
- ☐ C. the myelin sheath.
- ☐ D. the nodes of Ranvier.
- ☐ E. an outflow of sodium ions across the neural membrane.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nerve Functioning
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: nerve impulse neuron

INSTRUMENT CODE: B061KgMC.03
GUIDELINE OBJECTIVE CODE: 61Kg
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, C.4
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to evaluate the relevance of neurophysiological data to a specific problem.

Item

Which of the following observations or measurements would NOT be useful in ascertaining that conduction of nerve impulses is a chemical process rather than an electrical process?

- ☐ A. Examining electron micrographs of axon cross sections.
- ☐ B. Measuring of the velocity of conduction of nerve impulses.
- ☐ C. Monitoring changing concentrations of ions in the fluid surrounding neurons during stimulation of the neurons.
- ☐ D. Comparing oxygen consumptions of stimulated and unstimulated neurons.
- ☐ E. Determining the effect of temperature changes on the conduction process.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Nerve Functioning
 CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KgMC.04
 GUIDELINE OBJECTIVE CODE: 61Kg
 INSTRUMENT TYPE: MC
 KLOPPER: A.1, A.2, A.3, A.10
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

KEYWORDS: neuron action potential graphical analysis

Guideline Objective

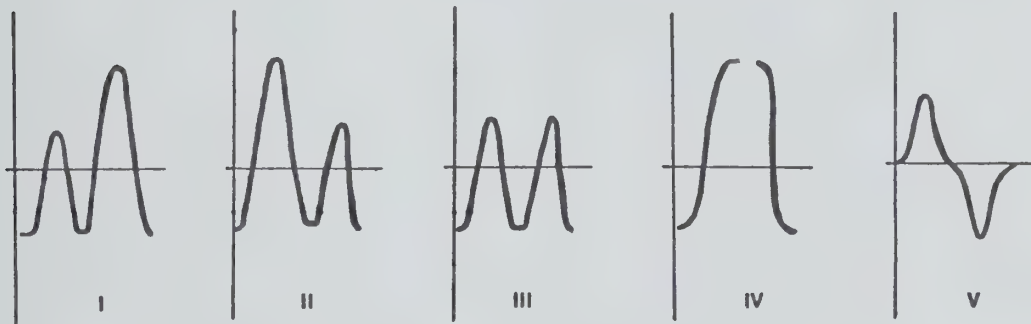
Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to apply the “all-or-none” principle to neuronal conduction.

Item

Refer to Figure 6K.20 at this point.



Two stimuli, the first of one millivolt and the second of ten millivolts, were applied in quick succession to an isolated neuron. Action potentials of the neuron were recorded. Which pattern in Figure 6K.20 would you expect to observe?

- ☐ A. I
☐ B. II
☐ C. III
☐ D. IV
☐ E. V

Response/Marking Scheme

Correct response: C

Teacher Notes

Item

Refer to Figure 6K.20 at this point.

Two stimuli, the first of one millivolt and the second of ten millivolts, were applied in quick succession to an isolated neuron. Action potentials of the neuron were recorded. Which pattern in Figure 6K.20 would you expect to observe?

- ☐ A. I
- ☐ B. II
- ☐ C. III
- ☐ D. IV
- ☐ E. V

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nerve Functioning

CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KgMC.05

GUIDELINE OBJECTIVE CODE: 61Kg

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.10, D.4

DIFFICULTY LEVEL: L

TIME ALLOCATION:

KEYWORDS: stimulus neuron action potential graphical analysis

Guideline Objective

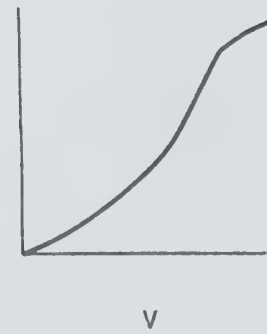
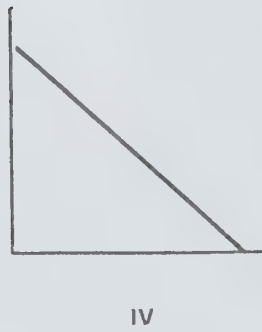
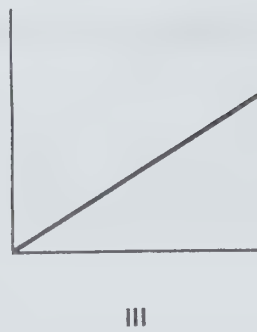
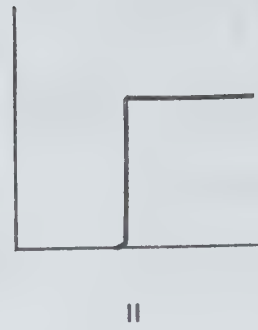
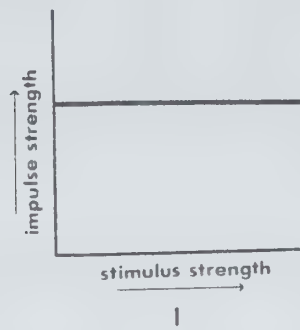
Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to apply the “all-or-none” principle to a new situation.

Item

Refer to Figure 6K.21.



Which graph in Figure 6K.21 best illustrates the relationship between the strength of the stimulus to an isolated neuron and the maximum height of the action potential which is caused by the stimulus?

- ☐ A. I
- ☐ B. II
- ☐ C. III
- ☐ D. IV
- ☐ E. V

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nerve Functioning
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: synapse

INSTRUMENT CODE: B061KgMC.06
GUIDELINE OBJECTIVE CODE: 61Kg
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to identify the functions of a synapse.

Item

Which of the following are functions performed by synapses?

- I Speed the flow of impulses through networks of neurons
- II Filter out random impulses from neural circuits
- III Impose a one-way flow of information on neural networks
- IV Facilitation of a neural pathway
- V Inhibition of a neuron

Choose your response from

- ☐ A. II, III, IV, V only
- ☐ B. I, III, V only
- ☐ C. II, IV, V only
- ☐ D. I, II, III, IV, V
- ☐ E. IV and V only

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nerve Impulse

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: electrochemical gradient neuron

INSTRUMENT CODE: B061KgMC.07

GUIDELINE OBJECTIVE CODE: 61Kg

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.5

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to identify the nature of a nerve impulse.

Item

A nerve impulse can be described as

- ☐ A. a changing chemical gradient along a neuron.
- ☐ B. a changing electrical gradient along a neuron.
- ☐ C. a changing electrochemical gradient along a neuron.
- ☐ D. a physical chain reaction along a neuron.
- ☐ E. an electric current flowing through a neuron.

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Nerve Impulse
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: neuron

INSTRUMENT CODE: B061KgMC.08
GUIDELINE OBJECTIVE CODE: 61Kg
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to identify the conditions essential for maintaining a potential difference across the membrane of a resting neuron.

Item

The maintenance of an electrical potential difference across the membranes of resting neurons depends on the active transport of

- ☐ A. hydrogen and oxygen ions.
- ☐ B. potassium and sodium ions.
- ☐ C. phosphate ions.
- ☐ D. organic anions.
- ☐ E. organic cations.

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Types of Neurons

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KgSA.01

GUIDELINE OBJECTIVE CODE: 61Kg

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: sensory neuron motor neuron

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The same as above.

Item

Using a chart format, contrast sensory and motor neurons under the following headings:

- A. origin
- B. function
- C. location of the cell body
- D. direction of movement of the impulse
- E. importance to the organism

Response/Marking Scheme

		Type of Neuron	
		sensory	motor
A.	Origin	in sensory organs	in CNS
B.	Function	carry impulses to the CNS	carry impulses from the CNS to muscle or some effector organ
C.	Location of cell body	in ganglia outside CNS	in grey matter in CNS
D.	Direction of impulse movement	towards the CNS	away from CNS
E.	Importance to the organism	awareness of the environment	response to the environment

Teacher Notes

$5 \times 2 = \text{Maximum: } 10$

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nerve Impulse

CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KgSA.02

GUIDELINE OBJECTIVE CODE: 61Kg

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.3, D.3, D.6

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: membrane potential neural impulse graphical analysis

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

The student should be able to interpret a graph illustrating changes in the action potential along a neuron.

Item

Refer to Figure 6K.22 for this question.

THE CHANGE IN MEMBRANE POTENTIAL
IN RESPONSE TO A NEURAL IMPULSE

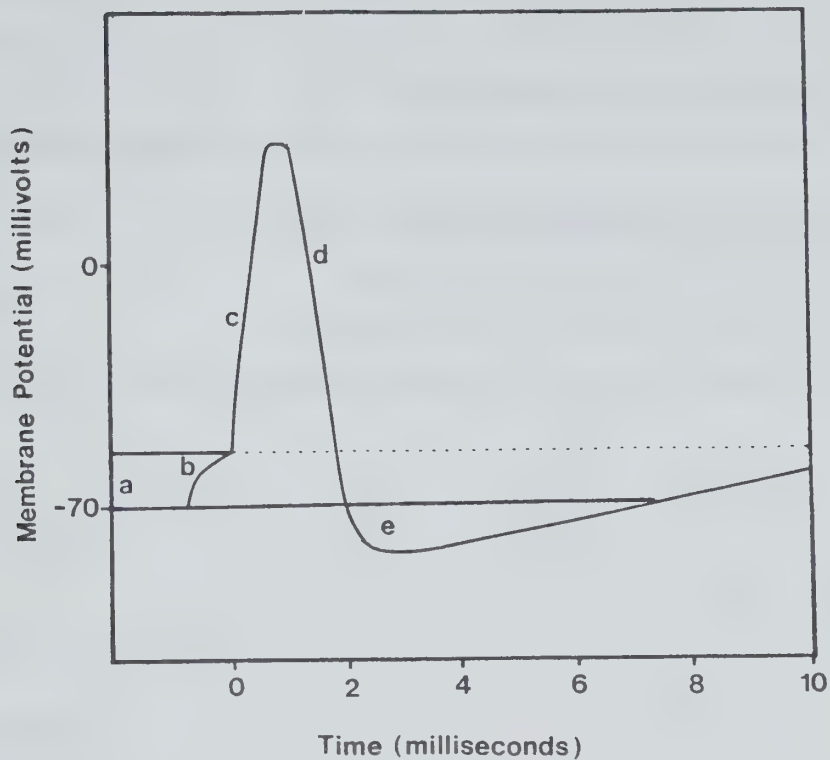


Figure 6K.22 represents the change in membrane potential as a neural impulse passes through a cell. Explain the occurrences in the cell that are illustrated by the graph. For each letter on the graph, describe and explain the event(s) occurring at that point.

Response/Marking Scheme

The graph represents an ideal response of a membrane to a neural impulse. 1

The cell, which is originally at its resting potential (a), first experiences a gradual (b), 2

then rapid (c) depolarization (changes from negative on the inside/positive on the outside to positive on the inside/negative on the outside). 2

This excess positive charge inside the cell is rapidly lost (d), when repolarization takes place. 1

The cell actually temporarily drops below its original resting level (e) before returning to its original resting potential. 1

Possible: 10

Maximum: 8

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Nerve Impulse

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: nerve impulse threshold

INSTRUMENT CODE: B061KgSA.03

GUIDELINE OBJECTIVE CODE: 61Kg

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to explain how nerve impulses travel along and between neurons.

Item Focus

Same as above.

Item

Explain the use of the following phrases in relation to a how nerve impulses travel along and between neurons.

A. a “chemical-electrical change”,

B. “threshold”,

C. “self-propagating”,

D. “one-way flow”.

Response/Marking Scheme

- A. Chemical: A resting potential is established and discharged as a result of the movement across the membrane of sodium and potassium ions. 1
- The release of a transmitter chemical compound, such as acetylcholine, transmits an impulse across a synapse. 1
- Electrical: A wave of electrical depolarization passing along a nerve fibre constitutes nerve transmission. 1
- B. The impulse either starts or it doesn't: there are no strong and weak impulses. Below the threshold value, there is no impulse; above it, complete depolarization. 1
- If the resting potential is reduced to the threshold value (-50 mV), then complete depolarization occurs, starting a nerve impulse. 1
- C. A depolarization at one point on a nerve fibre affects the permeability of the membrane immediately adjacent to it, causing depolarization there in turn; this wave of depolarization continues along the fibre. 2
- D. The synapse is the structure that determines that impulses will flow just one way along a neural network. 1
- Only the synaptic knob of an axon is capable of releasing the transmitter compound. 1
- Since the end of a dendrite does not produce the transmitter compound, a nerve impulse travelling from a cell body along a dendrite will stop at a synapse. 1

Possible: 10

Maximum: 10

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormonal Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: glucagon thyroxin parathormone

INSTRUMENT CODE: B061KhER.01
GUIDELINE OBJECTIVE CODE: 61Kh
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the following terms: endocrine gland, hormone, target organ.

Item Focus

The student should be able to define terms associated with hormonal control in a mammal and describe the functioning of specific hormones.

Item

A definition of the term *hormone* is: "A secretion of an endocrine gland that is carried by the circulatory system to stimulate another organ or physiological action."

Describe how two of the following hormones illustrate all three aspects of the definition:

glucagon
thyroxin
parathormone

Response/Marking Scheme

Accept any two of the following @ 3 marks each

Glucagon: is produced in the alpha cells of the islets of Langerhans,	1
carried by the blood to the liver, muscles and fat storage cells,	1
where it stimulates the conversion of glycogen or fats to glucose.	1
Thyroxin: is produced in the thyroid gland,	1
carried by the blood to cells throughout the body,	1
where it raises the metabolic level, releasing energy.	1
Parathormone: is produced in the parathyroid glands,	1
carried by the blood to the bones,	1
where it raises the level of calcium ions in the blood.	1

Possible: 6

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Cell Regulation

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: hormone target cell target protein

INSTRUMENT CODE: B061KhER.02

GUIDELINE OBJECTIVE CODE: 61Kh

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the following terms: endocrine gland, hormone, target organ.

Item Focus

The student should be able to outline the current hypothesis about how hormones affect cell membranes to control homeostasis.

Item

Hormones are carried by the blood to all parts of the body. Yet only certain cells respond to the presence of a particular hormone to carry out homeostatic control.

Outline the current hypothesis about how a hormone activates specific cells to react.

Response/Marking Scheme

The target cells of particular hormones are thought to have specific target protein molecules in their cell membranes. 2

These receptor molecules might produce a messenger molecule inside the cell, perhaps an enzyme that might activate a specific reaction. 2

One way that the hormone might act is to change the permeability of the cell membrane, allowing osmosis to proceed at a faster rate. 1

Another way would be by facilitating active transport. 1

Possible: 6

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Control of Homeostasis
 CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061KhER.03
 GUIDELINE OBJECTIVE CODE: 61Kh
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, A.5, A.9, A.11
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

KEYWORDS: hormone target cell insulin

Guideline Objective

Students will be expected to explain the following terms: endocrine gland, hormone, target organ.

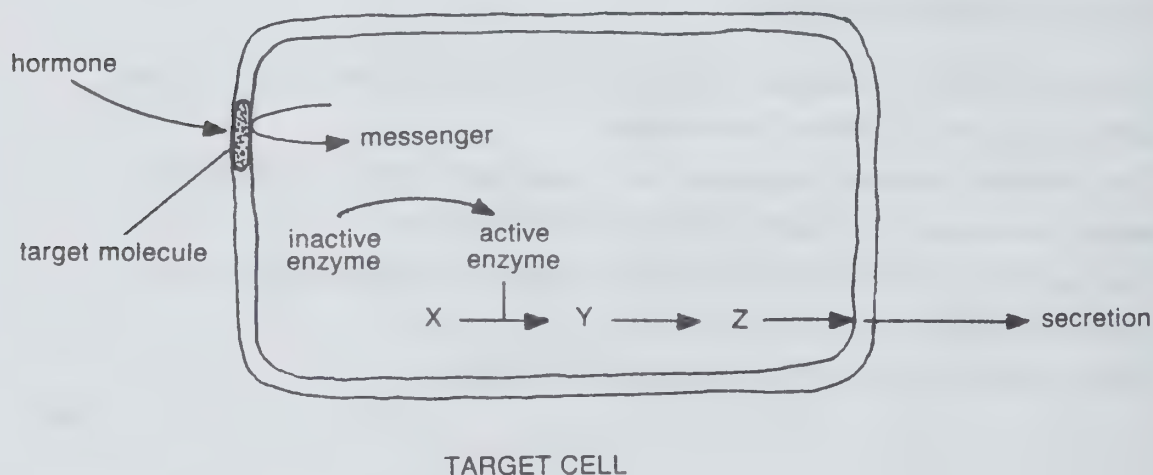
Item Focus

The student should be able to explain a model that represents the interaction of a hormone with its target cells.

Item

Refer to Figure 6K.23.

HYPOTHETICAL MODEL TO ACCOUNT FOR THE ACTION OF A HORMONE ONLY ON SPECIFIC TARGET CELLS.



Hormones are carried by the blood to all the cells of the body, yet they exert their control only on specific target cells.

Use the model shown in Figure 6K.23 to explain a possible action of insulin in the human body.

Response/Marking Scheme

The main target cells for insulin are liver cells.	1
When insulin reaches the cell membrane of a liver cell, it may activate a specific protein target molecule	2
in the cell membrane. This molecule may release a messenger molecule into the cell	1
causing the enzyme <u>phosphorylase</u> to	1
change glucose into glucose-6-phosphate	2
so that it can be built into the polymer, glycogen,	2
for storage in a form that will not be biologically active.	2
By diffusion, other glucose molecules will leave the blood and extracellular fluid and enter the cell reducing the level of glucose in the blood.	2
Another action in some cells is to convert glucose into fats or proteins, or to increase the rate of metabolism, using up glucose.	2

Possible: 15

Maximum: 10

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: endocrine gland hormone target organ

INSTRUMENT CODE: B061KhSA.01

GUIDELINE OBJECTIVE CODE: 61Kh

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to explain the following terms: endocrine gland, hormone, target organ.

Item Focus

Same as above.

Item

Explain the following terms:

A. endocrine gland

B. hormone

C. target organ

Response/Marking Scheme

- | | |
|---|---|
| A. Endocrine gland - a gland whose hormone secretion | 1 |
| enters the body fluids directly, | 1 |
| rather than by being transported to its site of action by a duct. | 1 |
| B. Hormone - a substance that is produced in one part of the body | 1 |
| and influences certain activities of specific cells | 1 |
| in other parts of the body. | 1 |
| C. Target organ - one containing cells which hormones | 1 |
| act on in a highly specific manner. | 1 |

The target cells carry receptor molecules that recognize and bind to specific hormone molecules.	1
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Possible: 9

Maximum: 7

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Hormones

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: thyroxin basal metabolism

INSTRUMENT CODE: B061KiMC.01

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a specific hormone from its effect.

Item

Which of the following hormones increases the rate of basal metabolism in the body?

- ☐ A. cortisone
- ☐ B. insulin
- ☐ C. thyroxin
- ☐ D. melatonin
- ☐ E. calcitonin

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: insulin glucagon

INSTRUMENT CODE: B061KiMC.02
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a pair of antagonistic hormones.

Item

One form of homeostasis is achieved by the interaction of a pair of antagonistic hormones, each of which has effects that are the opposite of the other's. Which of the following is an antagonistic pair of hormones?

- ☐ A. insulin and secretin
- ☐ B. glucagon and insulin
- ☐ C. cortisol and insulin
- ☐ D. ACTH and insulin
- ☐ E. secretin and glucagon

Response/Marking Scheme

Correct response: B

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: glucose insulin

INSTRUMENT CODE: B061KiMC.03
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify the processes involved in the regulation of the level of glucose in the blood.

Item

Which of the following processes affect(s) the level of glucose in mammalian blood?

I production of insulin

II conversion of glucose to fat

III excretion of glucose into the urine

IV breakdown of glycogen

Select your answer from:

☐

A. I only

☐

B. I and II only

☐

C. I, II and III only

☐

D. II and III only

☐

E. I, II, III and IV

Response/Marking Scheme

Correct response: E

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: glucagon

INSTRUMENT CODE: B061KiMC.04
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH) , antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a hormone involved in the homeostasis of blood sugar.

Item

When the blood sugar level is low, which of the following hormones is secreted?

- ☐ A. insulin
- ☐ B. secretin
- ☐ C. ACTH
- ☐ D. glycogen
- ☐ E. glucagon

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiMC.05
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

KEYWORDS: vasopressin antidiuretic hormone (ADH)

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify the effect of vasopressin.

Item

Which of the following is controlled by ADH (vasopressin or antidiuretic hormone)?

- ☐ A. the level of glucose in the blood
- ☐ B. the amount of water reabsorbed in the nephron
- ☐ C. the development of the lining of the uterus
- ☐ D. the release of an ovum (egg) from the ovary
- ☐ E. the uptake of calcium by the bones

Response/Marking Scheme

Correct response: B

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiMC.06
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: homeostasis metabolism hormones thyroid

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify the control system of the thyroid gland.

Item

Homeostasis in complex animals is achieved by several mechanisms. The fine-tuning of the hormonal control of metabolism concerns the thyroid gland. The thyroid is regulated by feedback loops involving

- ☐ A. the pituitary gland and two hormones.
- ☐ B. the adrenal cortex and three hormones.
- ☐ C. the hypothalamus, the pituitary, and three hormones.
- ☐ D. The Islets of Langerhans and three hormones.
- ☐ E. the hypothalamus, pancreas, and four hormones.

Response/Marking Scheme

Correct response: C

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: hormone pancreas

INSTRUMENT CODE: B061KiMC.07
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify the functions of specific hormones.

Item

Which of the following is the function of the hormones produced in the pancreas?

- ☐ A. secretion of digestive enzymes.
- ☐ B. raising the pH of the blood.
- ☐ C. stimulating the flow of gastric juice.
- ☐ D. regulation of the sugar content of the blood.
- ☐ E. stimulating the contraction of the gall bladder.

Response/Marking Scheme

Correct response: D

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: pituitary

INSTRUMENT CODE: B061KiMC.08
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a function of the pituitary gland.

Item

The pituitary is sometimes called “the master gland” because it

- ☐ A. stimulates other endocrine glands.
- ☐ B. controls the functioning of the brain.
- ☐ C. is the largest endocrine gland.
- ☐ D. controls growth.
- ☐ E. regulates the blood pressure.

Response/Marking Scheme

Correct response: A

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: metabolism

INSTRUMENT CODE: B061KiMC.09
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, A.10
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a hormone that produces a specific effect.

Item

If a person has an abnormally low rate of metabolism, a physician may prescribe the hormone,

- ☐ A. secretin.
- ☐ B. insulin.
- ☐ C. pepsin.
- ☐ D. thyroxin.
- ☐ E. cortisone.

Response/Marking Scheme

Correct response: D

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology	INSTRUMENT CODE: B061KiMC.10
LEVEL: OAC	GUIDELINE OBJECTIVE CODE: 61Ki
UNIT NUMBER: 06	INSTRUMENT TYPE: MC
UNIT NAME: HOMEOSTASIS	KLOPPER: A.1, A.2, A.3
TOPIC: Endocrine system	DIFFICULTY LEVEL: L
CURRICULAR EMPHASIS: Solid Foundations	TIME ALLOCATION:
KEYWORDS: posterior pituitary gland vasopressin (ADH)	

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a hormone produced by the posterior pituitary gland.

Item

Which one of the following hormones is produced by the posterior pituitary gland?

- ☐ A. gonadotropin
- ☐ B. thyroid stimulating hormone (TSH)
- ☐ C. thyroxin
- ☐ D. testosterone
- ☐ E. antidiuretic hormone (ADH, or vasopressin).

Response/Marking Scheme

Correct response: E

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: metabolic rate hormone

INSTRUMENT CODE: B061KiMC.11
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2.
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a hormone from its function.

Item

Which of the following hormones increases the rate of metabolism of the human body?

- ☐ A. thyroxin
- ☐ B. parathormone
- ☐ C. insulin
- ☐ D. FSH (follicle stimulating hormone)
- ☐ E. antidiuretic hormone (ADH, or vasopressin)

Response/Marking Scheme

Correct response: A

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: calcium ion endocrine gland

INSTRUMENT CODE: B061KiMC.12
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify an endocrine gland given its function.

Item

Which of the following endocrine glands secretes a hormone that helps to regulate the concentration of calcium ions in the blood?

- ☐ A. thymus
- ☐ B. adrenal medulla
- ☐ C. posterior lobe of the pituitary
- ☐ D. parathyroids
- ☐ E. pancreas

Response/Marking Scheme

Correct response: D

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: thyroxin

INSTRUMENT CODE: B061KiMC.13
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify a hormone that requires iodine for its synthesis.

Item

A diet deficient in iodine will result in insufficient production of the hormone,

- ☐ A. thyroxin.
- ☐ B. glucagon.
- ☐ C. thyroid stimulating hormone (TSH).
- ☐ D. antidiuretic hormone (ADH).
- ☐ E. noradrenalin (epinephrine).

Response/Marking Scheme

Correct response: A

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormones
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: glucagon pancreas

INSTRUMENT CODE: B061KiMC.14
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify the endocrine glands that secrete a particular hormone.

Item

The hormone, glucagon, is secreted by the

- ☐ A. pituitary.
- ☐ B. parathyroids.
- ☐ C. thyroid.
- ☐ D. liver.
- ☐ E. pancreas.

Response/Marking Scheme

Correct response: E

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Homeostatic Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: reabsorption feedback

INSTRUMENT CODE: B061KiER.01
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.5, A.11
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to describe the control of the reabsorption of water in the mammal.

Item

Describe how hormones are involved in the reabsorption of water in the kidney of a mammal.

Response/Marking Scheme

In the proximal part of the convoluted tubule, most of the water is reabsorbed.

The control of reabsorption of water 1

occurs in the ascending portion of the loop of Henle, and in the distal convoluted tubule of the nephron. 2

Cells lining these tubules are affected by hormones from the anterior pituitary (ADH, antidiuretic hormone, or vasopressin) and the cortex of the adrenal glands (aldosterone). 2

Both of these hormones make the cell membranes more permeable, allowing them to absorb more water from filtrate. 2

These hormones thus maintain the osmotic pressure of the 1

ECF. Osmoreceptors in the hypothalamus detect changes in 2

the concentration of the water in the plasma, and signal the anterior pituitary to release or inhibit the production of ADH. 1

Possible: 10

Maximum: 7

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Hormonal Feedback Systems
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiER.02
GUIDELINE OBJECTIVE CODE: 61Ki
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.5.
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: feedback antidiuretic hormone ADH (vasopressin)

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to explain how feedback control of the antidiuretic hormone is accomplished in the human body.

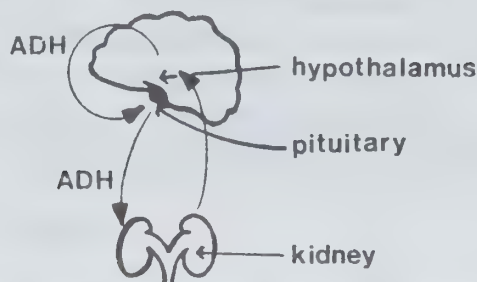
Item

With the aid of a labelled diagram, explain how feedback control of the antidiuretic hormone (ADH, or vasopressin) is accomplished in the human body.

Response/Marking Scheme

Diagram:

3



Labels:

3

The hypothalamus manufactures the hormone ADH (vasopressin)

1

and passes it down the stalk into the pituitary, where

1

it is stored. The hypothalamus secretes releasing factors

1

to stimulate the pituitary to release ADH (vasopressin).

1

ADH (or vasopressin) is released from the pituitary gland

1

and carried by the blood to target cells in the

2

distal convoluted tubule of each nephron in the kidney.

2

Here, ADH increases the reabsorption of water.

2

The change in blood osmolarity resulting from increased

1

reabsorption is detected by the hypothalamus, which

1

stops producing releasing factor, shutting off the ADH.

1

Possible: 20

Maximum: 15

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Biological Control

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: hormone glucagon insulin

INSTRUMENT CODE: B061KiMA.01

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: MA

KLOPPER: A.1, A.2, A.3, A.5, A.8, A.11

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

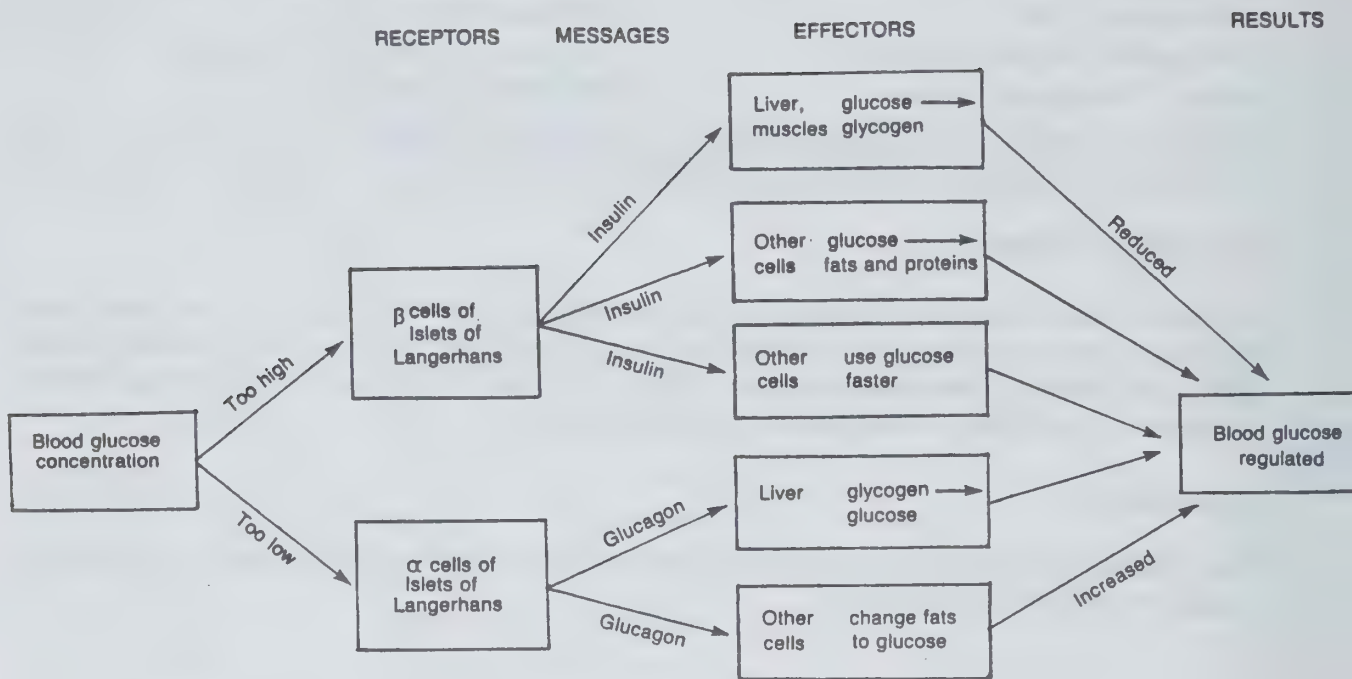
Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify mechanisms and substances involved in the homeostatic control of blood glucose.

Item

Refer to Figure 6K.25.



The diagram in Figure 6K.25 summarizes the mechanisms and substances involved in the homeostatic control of glucose in the blood of a mammal. Match the terms with the appropriate statements by placing the letter of the statement in the blank to the left of the corresponding term.

1. ____ glucagon

2. ____ insulin

3. ____ antagonistic

4. ____ hormone

5. ____ glucose

6. ____ islets of Langerhans

A. the controlled entity is maintained within limits varying by 0.1%

B. groups of cells within the pancreas

C. phosphorylated glucose reacts faster

D. raises the level of glucose in blood

E. lowers the level of glucose in blood

F. carried by the blood to effect control of an organ at some distance

G. two hormones act antagonistically.

Response/Marking Scheme

Correct responses:

1 - D, 2 - E, 3 - G, 4 - F, 5 - A, 6 - B.

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiMA.02

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: MA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: endocrine glands hormones

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to match a number of endocrine glands, hormonal secretions, and functions.

Item

Place the letter and number of the most appropriate word or phrase from Columns 2 and 3, respectively, in the space provided on the left of each word in Column 1. No term or function can be used more than once.

Column 1

_____, _____ placenta

_____, _____ islets of Langerhans

_____, _____ duodenum

_____, _____ anterior pituitary

_____, _____ thyroid

_____, _____ testes

Column 2

a. parathyroid

b. thyroxin

c. glucocorticoids

d. testosterone

e. adrenalin (epinephrine)

f. insulin

g. prolactin

h. estrogen

i. secretin

Column 3

1. decreases blood hormone sugar

2. stimulates milk production

3. "fight or flight" response

4. male sex characteristics

5. maintains pregnancy

6. increases blood sugar

7. increases blood pressure

8. stimulates bile production

9. controls metabolic rate

Response/Marking Scheme

Correct responses:

Column 1

h, 5 placenta

f, 1 islets of Langerhans

i, 8 duodenum

g, 2 anterior pituitary

b, 9 thyroid

d, 4 testes

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: endocrine gland hormone target organ

INSTRUMENT CODE: B061KiMA.03

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: MA

KLOPPER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to match the hormones with their target organ.

Item

Match the following hormones with their target organ. Not all the target organs need be used. A target organ may be used more than once.

Hormone	Target Organ
A. — glucagon	1. testes
B. — thyrotropin	2. kidney
C. — vasopressin	3. liver
D. — noradrenalin (norepinephrine)	4. pituitary gland
E. — aldosterone	5. sympathetic nervous system
	6. thyroid

Response/Marking Scheme

Correct responses:

A - 3, B - 6, C - 2, D - 5, E - 2

Maximum: 5

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Hormonal Feedback Systems

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: thyroxine thyrotropin releasing hormone thyrotropin hypothalamus
anterior pituitary

INSTRUMENT CODE: B061KiMa.04

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: Ma

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

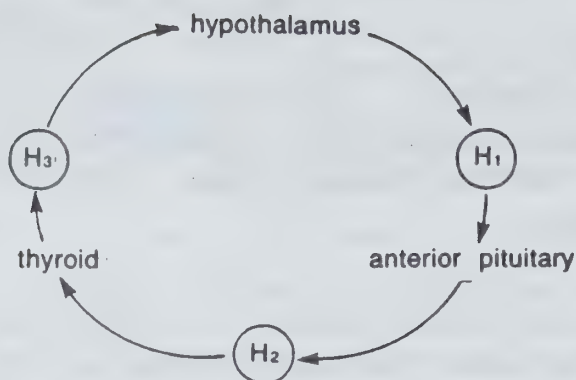
Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxin, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify hormones and their functions, given a diagram of the endocrine glands and the feedback pathways involved.

Item

Refer to Figure 6K.26.



Study the diagram and the lists of hormones and hormonal functions provided below. Complete the table relating each hormone to its functioning role in the diagram.

Hormones:

- thyroxin
- thyrotropin releasing hormone
- thyrotropin (thyroid-stimulating hormone)

Functions:

- stimulates release of thyrotropin
- increases metabolic rate
- stimulates release of thyroxin
- affects production of thyrotropin releasing factor (TRF)

	Name of hormone	Functions
H ₁		
H ₂		
H ₃		

Response/Marking Scheme

	Name of hormone	Functions
H ₁	thyrotropin releasing factor	stimulates release of thyrotropin 2
H ₂	thyrotropin (TSH)	stimulates release of thyroxin 2
H ₃	thyroxin	increases metabolic rate affects production of thyrotropin releasing factor 3

Possible: 7

Maximum: 7

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Hormones

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: endocrine glands hormones

INSTRUMENT CODE: B061KiSA.02

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

Same as above.

Item

Complete the following table to show the gland which produces each of the following hormones, its specific location in the body, the target organ affected by the hormone, and the effect of the hormone.

HORMONE	SOURCE	LOCATION	TARGET	EFFECT
parathyroid hormone (PTH)				
glucagon				
thyroid stimulating hormone (TSH)				
antidiuretic hormone (ADH, or vasopressin)				
adrenalin (epinephrine)				

Response/Marking Scheme

HORMONE	SOURCE	LOCATION	TARGET	EFFECT
parathyroid hormone (PTH)	parathyroids	on the thyroid in the neck	bones	regulates calcium and phosphate in blood
glucagon	pancreas: Islets of Langerhans	in the pancreas, below stomach	liver, fat cells	raises level of glucose in blood
thyroid stimulating hormone (TSH)	hypothalamus	under the cerebral cortex	thyroid	increases rate of secretion
antidiuretic hormone (ADH, or vasopressin)	pituitary posterior lobe	suspended below the cerebral cortex	kidneys	increases re-absorption of water
adrenalin (epinephrine)	adrenal medulla	superior to kidneys	muscles and all cells	elevates plasma glucose for fight or flight reaction

Teacher Notes

Maximum: 5 X 4 = 20

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Biological Control

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiSA.03

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: calcium ions calcitonin thyroid

Guideline Objective

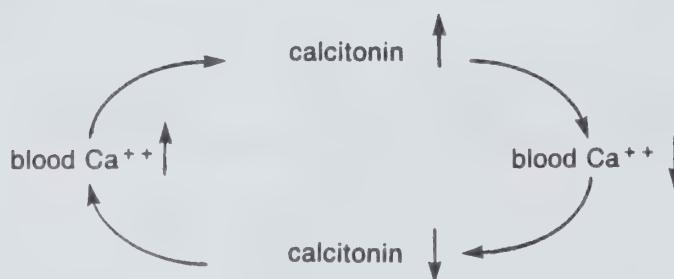
Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to explain the control of calcium ions in the blood.

Item

Explain the negative feedback loop shown below, and state its significance in homeostasis in the human body.



Note: ↑ = increased level in body fluids
 ↓ = decreased level in body fluids

Response/Marking Scheme

A rise in the level of Ca^{2+} in the blood	1
stimulates the secretion of the hormone, calcitonin	1
by the thyroid gland.	1
Calcitonin causes cells in the bone to absorb calcium ions from the blood,	1
decreasing the level of Ca^{2+} in the blood.	1
The reduced level of calcium ions in the blood shuts down the secretion of calcitonin by the thyroid.	1
The significance of this mechanism is that it is one of the control systems by which the level of calcium ions in the blood is maintained within narrow limits.	1
Possible:	7

Maximum: 7

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Hormonal Feedback Systems

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiSA.04

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: testosterone luteinizing hormone anterior pituitary testes

Guideline Objective

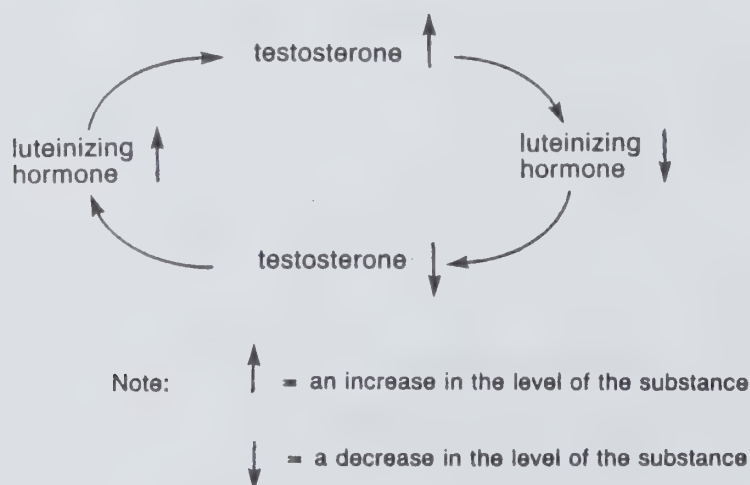
Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to explain a hormonal feedback loop, and state the significance of its functioning.

Item

Explain the hormonal feedback loop shown below, and state its significance in the production of sperm by a male vertebrate.



Response/Marking Scheme

Luteinizing hormone (LH) stimulates the secretion of testosterone by the testes.	1
The presence of testosterone in the blood inhibits the secretion of LH by the anterior pituitary.	1
As the level of testosterone rises, the level of LH falls, reducing the output of testosterone by the testes.	1
When the level of testosterone falls low enough, the inhibition stops, and the LH secretion begins again.	1
This stimulates the secretion of testosterone again.	1
<u>Significance:</u>	
A male vertebrate must have the correct levels of both testosterone and LH in order for the testes to produce sperm.	1
The rise or fall in the level of either hormone is automatically corrected by the other.	1

Possible: 7

Maximum: 7

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiSA.06

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

KEYWORDS: endocrine gland hormone target organ

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify five different hormones and target organs.

Item

Complete the column entitled "Target Organ" in the following table.

Endocrine gland	Hormone	Target Organ
1. alpha cells of pancreas	glucagon	
2. anterior pituitary	thyrotropin	
3. hypothalamus via posterior pituitary	vasopressin	
4. medulla of adrenal glands	noradrenaline (norepinephrine)	
5. adrenal cortex	aldosterone	

Response/Marking Scheme

Correct responses:

- 1 - liver
- 2 - thyroid
- 3 - kidney
- 4 - sympathetic nervous system
- 5 - kidney

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KiSA.07

GUIDELINE OBJECTIVE CODE: 61Ki

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2

DIFFICULTY LEVEL: L

TIME ALLOCATION:

KEYWORDS: endocrine gland hormone target organ

Guideline Objective

Students will be expected to describe the source (including the location of the gland) and the role of any two related hormones, for example, thyroxine, parathyroid hormone, insulin, glucagon, thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), adrenalin, noradrenalin, cortisone, aldosterone and sex hormones.

Item Focus

The student should be able to identify the endocrine gland that produces a particular hormone.

Item

Complete the column entitled "Endocrine Gland" in the following table.

Endocrine Gland	Hormone	Target Organ
1.	glucagon	liver
2.	thyrotropin	thyroid
3.	vasopressin	kidney
4.	noradrenalin (norepinephrine)	sympathetic nervous system
5.	aldosterone	kidney

Response/Marking Scheme

- 1 - alpha cells of pancreas
- 2 - anterior pituitary
- 3 - hypothalamus (via posterior pituitary)
- 4 - medulla of adrenal glands
- 5 - adrenal cortex

Maximum: 5

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Water Balance
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: body fluid

INSTRUMENT CODE: B061KjMC.01
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to identify the factors associated with the reabsorption of water in the body.

Item

In the event of dehydration, body fluid volume can be restored by:

I reabsorbing more water.

II drinking a quantity of alcoholic beverage.

III excreting more salt to make water more isotonic.

IV reabsorbing more salt so that water follows.

Select your answer from the following:

- ☐ A. I only
- ☐ B. I and IV only
- ☐ C. II and III only
- ☐ D. I, II, and III only
- ☐ E. I, II, and IV only

Response/Marking Scheme

Correct response: B

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Thermoregulation
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: hypothalamus homeotherm

INSTRUMENT CODE: B061KjMC.02
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to identify the main temperature regulating region of the body.

Item

The main organ of the body of a homeotherm for sensing and regulating temperature is the

- ☐ A. cerebral cortex.
- ☐ B. hypothalamus.
- ☐ C. thyroid.
- ☐ D. erector pili muscle.
- ☐ E. adrenal gland.

Response/Marking Scheme

Correct response: B

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: thermoregulation

INSTRUMENT CODE: B061KjMC.03
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to recognize mechanisms by which temperature can be regulated.

Item

Which of the following are means by which the body temperature of an organism is regulated?

I perspiration

II piloerection

III vasoconstriction

IV exercise

V sleeping

Select your answer from the following:

- ☐ A. I only.
- ☐ B. I and II.
- ☐ C. I, II, and III.
- ☐ D. I, II, III, and IV.
- ☐ E. I, II, III, IV, and V.

Response/Marking Scheme

Correct response: D

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: poikilotherm

INSTRUMENT CODE: B061KjMC.04
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to identify a poikilotherm.

Item

An organism that cannot maintain a constant body temperature by physiological means is called

- ☐ A. isotonic.
- ☐ B. homeothermic
- ☐ C. poikilothermic.
- ☐ D. pyrogenic.
- ☐ E. halophilic.

Response/Marking Scheme

Correct response: C

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: stress endocrine glands

INSTRUMENT CODE: B061KjEE.01
 GUIDELINE OBJECTIVE CODE: 61Kj
 INSTRUMENT TYPE: EE
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: H
 TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to explain the interaction of the nervous and hormonal systems of the body in response to a change in an external stimulus.

Item

Stress (e.g., cold or fright) initiates a number of processes within the body which involves neurons, endocrine glands (e.g., hypothalamus and adrenal glands), hormones (e.g., corticotropin-releasing hormone, CRH, and adrenocorticotrophic hormone, ACTH) and feedback regulatory systems.

- A. Use the above example to describe the interrelationship between neural and hormonal control.
- B. After the body has responded to the stressful situation, describe how the body returns to its normal functioning state.

Response/Marking Scheme

A. When the body is subjected to a stressful situation, receptor neurons transmit this	1
“message” to centres in the brain and on to	1
the hypothalamus. Here, specialized cells	1
called neurosecretory cells, secrete the hormone	1
corticotropin-releasing hormone (CRH) into blood	1
vessels which transmit the hormone to the anterior	1
pituitary gland. The CRH, in turn, stimulates	1
the release of the adrenocorticotrophic hormone	1
(ACTH) which now passes via the circulatory system	1
to the cortex tissue of the adrenal glands (located	1
on top of the kidneys). The ACTH stimulates the	1
adrenal cortex to produce glucocorticoids which	1
enter the blood stream. This final hormone affects	1
most cells of the body bringing about an increase	1
in available glucose from the liver. This increased	1
level of glucose in the blood enables the body to	1
activate the muscles and nerves in response to the	2
stress.	
 B. Once a specific glucocorticoid level in the blood is	1
reached, the hormone travels by the circulatory	1
system and shuts off the secretion of ACTH in the	1
anterior pituitary gland and the secretion of CRH in	1
the hypothalamus. In this manner, the body returns to a more normal	
operating level.	

Possible: 22

Maximum: 15

Quality: 2

Total: 17

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Control of pH

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: buffer pH protein structure

INSTRUMENT CODE: B061KjEE.02R

GUIDELINE OBJECTIVE CODE: 61Kj

INSTRUMENT TYPE: EE

KLOPPER: A.1, A.2, A.3, A.8

DIFFICULTY LEVEL: H

TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to state the need for differing degrees of buffering capacity in different parts of the body, and explain the mechanism for control of pH.

Item

The major cause of pain in the human body is the reduction of pH near naked (free) nerve endings. This is the result when the well-buffered cytoplasm (pH = 6.8) from damaged cells mixes with the less well-buffered extracellular fluid (pH = 7.4).

- A. Name a group of buffering agents that act both within the cytoplasm and in the extracellular fluid, and give one specific example.
- B. Name a group of buffering agents that act within the cytoplasm, but not to much extent in the extracellular fluid, and state why these agents can be considered superior to those named in A.
- C. Briefly explain the mechanism by which both groups of buffering agents control fluctuations in pH.
- D. Explain, in detail, why there might be more evolutionary pressure on organisms to regulate intracellular pH than to regulate extracellular pH.

Response/Marking Scheme

A. Inorganic ions act at both sites, such as hydrogen carbonate (bicarbonate) or dihydrogen phosphate.	1
B. Proteins act within cells, but not in ECF.	1
Each protein molecule has many buffering sites offering the advantage of high buffering capacity with minimal osmotic effect.	1
C. Both proteins and inorganic ions can bind or release hydrogen ions either to a discrete ion or to a group of atoms within the larger molecule. Whether they bind or release depends on the hydrogen ion concentration.	1
Buffers bind hydrogen if its ion concentration rises in their vicinity, and they release hydrogen ions if the concentration falls in their vicinity.	1
D. The tertiary structure, and hence the catalytic activity of enzymes is readily altered when pH changes.	1
Since enzymes interact in complex patterns with many other enzymes in the cell, and all enzymes within a sequence are not affected to the same extent by pH, the delicate balance among enzymes is disrupted by pH changes. This phenomenon is called “disproportionation”.	1
Many redox reactions involve hydrogen ions, so redox potentials of vital reactions would be altered if pH changed very much. Since vital metabolic reactions seldom occur in the ECF, organisms failing to evolve buffering mechanisms in the ECF would face little negative selection.	1

Possible: 19

Maximum: 15

Quality: 2

Total: 17

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KjER.01
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.5, A.9
DIFFICULTY LEVEL: H
TIME ALLOCATION:

KEYWORDS: polypeptide hormone activation cyclic AMP

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to describe how hormones work at the cellular level.

Item

Explain one way in which a polypeptide hormone can act upon a target cell.

Response/Marking Scheme

Polypeptide hormones diffuse through the extracellular fluid until they reach specific receptor cells.	1
These have specific receptor molecules in their	1
cell membranes. The hormone molecule combines with the receptor.	1
The combination hormone/receptor activates adenyl cyclase, a membrane protein.	1
This stimulates the conversion of ATP to cyclic AMP.	1
Cyclic AMP then combines with a catabolic gene activator protein,	1
which moves into the nucleus, and	1
combines with the catabolic gene activator site on a	1
previously inactive gene, and induces the RNA polymerase to transcribe the gene.	1
Messenger RNA moves out of the nucleus to ribosomes	1
to begin producing the required protein, which	1
directly or indirectly effects the response.	1

Possible: 12

Maximum: 8

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Thermoregulation
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS:

INSTRUMENT CODE: B061KjER.02
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to explain mechanisms of thermoregulation.

Item

Explain five thermoregulatory mechanisms employed by vertebrates.

Response/Marking Scheme

(any 5 @ 2 marks each)

Countercurrent Exchange - arteries and veins run parallel and in close proximity to each other. This encourages heat to pass from the blood in the arteries to the cooler blood in the veins and hence, maintain a more uniform temperature in the extremities of animals.

Vary the Metabolic Rate - Increased metabolic rate increases heat production. Some organisms have the capability of decreasing their metabolic rate and entering into a state of hibernation during harsh conditions.

Piloerection - making the hair stand on end. This increases the dead air space around the skin and acts as an insulating factor.

Fat - Fat does not contain many blood vessels and therefore, discourages the release of heat from the body. As well, it is a good insulator.

Sweating and Panting - The film of water on the surface of the body can evaporate. This process removes heat from the environment surrounding the evaporating material - the skin, and hence, cools the area. This process is dependent upon a vehicle for placing moisture on the body surface. Such vehicles include sweat glands and the tongue of a dog where the moisture is given off through panting.

Vasoconstriction and Vasodilation - of blood vessels reduces and enhances, respectively, the liberation of heat from the body.

Behaviour - Moving to a warmer or cooler environment alleviates the stress on the body of temperature differentials. This could take the form of moving to a more thermally stable environment such as water or underground; changing the environment to suit the organism, i.e. housing; huddling close to other organisms.

Shivering and Voluntary Muscle Contraction - Muscle activity increases its temperature and therefore, that of the body.

Brown Fats

In some mammals, in cold climates, brown fats are used to generate

additional heat.

Maximum: $(5 \times 2) = 10$

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Feedback Systems

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: thermoregulation negative feedback hypothalamus

INSTRUMENT CODE: B061KjER.04

GUIDELINE OBJECTIVE CODE: 61Kj

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.3, A.5, A.9

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to describe the concept of "negative feedback".

Item

Describe what is meant by the term "negative feedback", using the homeotherm's (endotherm's) response to exercise to illustrate your answer.

Response/Marking Scheme

Negative feedback is a mechanism in which part of the output from a system is used to change the activity of the system.	3
Muscle activity due to friction and an increased metabolic rate cause the blood temperature to rise.	2
The hypothalamus detects this increase in blood temperature. It responds through the parasympathetic nervous system by dilating the arterioles in the skin and inducing sweating.	1
	1
	1
	1
	1
	1
As well, an increased metabolism results in a greater demand for oxygen and hence a more rapid breathing rate and deeper breathing.	1
Consequently, more heat can be dissipated from the lungs.	1
Dilation of arterioles in the skin allows for the dissipation of excess heat.	1
Evaporation from the skin and the lungs results in cooler surfaces, therefore the blood is cooled	1
When this happens, under the direction of the hypothalamus, arterioles in the skin return to normal	1
Differential shunting of blood from some arteriole beds to others allows for loss of heat and a lower average temperature.	2
Increased stroke volume of the heart results in greater output of blood, increasing the efficiency of removal of heat.	2

Possible: 20

Maximum: 15

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Thermoregulation
CURRICULAR EMPHASIS: Communication

INSTRUMENT CODE: B061KjER.05R
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.5, A.9, E.2
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: homeotherm hypothalamus

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

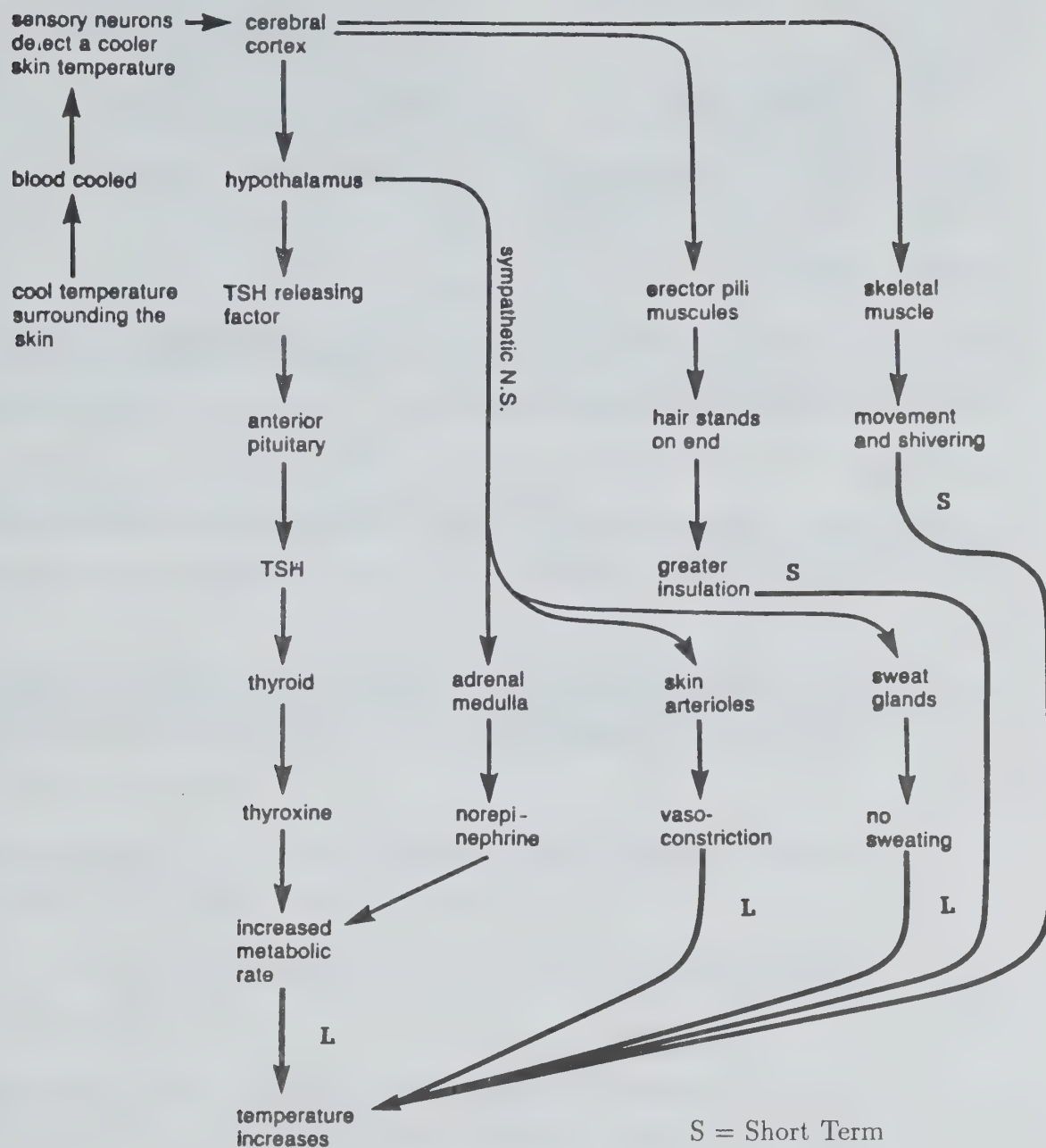
Item Focus

The student should be able to describe the events of the response of a homeotherm to a cooler environment in an attempt to regulate its temperature.

Item

Using a flow diagram, illustrate the mechanism by which homeotherms maintain a normal body temperature in response to a cold environment. On the diagram, differentiate between short term and longer term responses.

Response/Marking Scheme



S = Short Term

L = Long Term

Possible: 25

Maximum: 20

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Biological Control

CURRICULAR EMPHASIS: Solid Foundations

KEYWORDS: homeotherms hibernation fever

INSTRUMENT CODE: B061KjER.06

GUIDELINE OBJECTIVE CODE: 61Kj

INSTRUMENT TYPE: ER

KLOPFER: A.1, A.2, A.3, A.5

DIFFICULTY LEVEL: M

TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to discuss situations in which temperature of organisms is not within the "normal" range.

Item

While the body temperature of homeotherms, generally, remains within a narrow range, discuss four situations in which this statement would not be true. Provide an example of each.

Response/Marking Scheme

Any 4 @ 2 marks each

1. Hibernation - certain animals, eg., ground squirrel, to reduce their metabolic requirements over a period when food is scarce, reduce their body temperature and therefore their metabolism.
2. Fever - as an immune response to infectious organisms, the body temperature is increased, resulting in the ability to wage a more effective fight against the foreign body.
3. A Hedge Against Extreme Heat - Camels reduce their body temperature at night in order to begin the day with a lower body temperature, thus increasing their tolerance to the heat of the day.
4. Exercise - Muscle contraction generates heat and therefore, will increase the body core temperature, and increase oxygen requirements.
5. Hypothermia - This is a situation in which the body temperature of an organism drops below normal due to a very cold environment. The organism can lapse into unconsciousness, and in the extreme circumstance, die, if the condition is not reversed.
6. Hormonal Disorder - An excess or deficiency of thyroxin can affect metabolism, accelerating or slowing the rate of production of heat.
7. Diet - The high protein diet may stimulate the rate of metabolism, affecting the production of heat.
8. Hyperthermia - This is a situation in which the body temperature of an organism is elevated by a hot environment. Examples: heat stroke, working by a blast furnace

Possible: 14

Maximum: 8

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Thermoregulation
CURRICULAR EMPHASIS: Nature of Science
KEYWORDS: homeotherm

INSTRUMENT CODE: B061KjER.07
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.5, A.9
DIFFICULTY LEVEL: H
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to discuss the mechanisms responsible for decreasing body temperature in response to a higher than normal ambient temperature.

Item

About 200 years ago, Charles Blagden, then secretary of the Royal Society of London, along with two friends, a dog, entered a room whose temperature was 126°C, considerably above the point that water boils. They took a steak into the room with them. At the end of a 45 minute period, the three persons and the dog emerged alive. The steak, however, was cooked.

What mechanisms, present in living organisms but absent in the steak, were responsible for their survival?

Response/Marking Scheme

- as skin temperature rose, sensory nerve endings sent messages to the cerebral cortex that the surrounding temperature was unusually hot 3
- consequently, voluntary muscle activity was reduced to a minimum 1
- the blood temperature rose 1
- blood circulating through the hypothalamus (Ca^{2+} increase and therefore, $\text{Ca}^{2+}/\text{Na}^{+}$ imbalance) triggered the hypothalamus to respond by dilating the peripheral blood vessels (autonomic nervous system) and causing profuse sweating 1
- the sweating allowed for evaporation which draws heat away from the body 1
- this cooling effect was transmitted to the blood in the capillaries in the skin, thereby cooling the body 1
- this situation can compensate for a limited period of time until the larger body mass warmed to a degree that metabolic heat as well as environmental heat increased the metabolic rate thereby further increasing the demand for oxygen, the breathing rate, and finally, the temperature 1
- a message from the cerebral cortex elicits a behavioural response to move to a cooler temperature 2
- the dog, in part, reduces its body temperature by panting, not to be confused with sweating. 1

Possible: 17

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: thermoregulation

INSTRUMENT CODE: B061KjER.08
 GUIDELINE OBJECTIVE CODE: 61Kj
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3, A.11
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

Same as above.

Item

"Mad dogs and Englishmen go out in the midday sun." (Kipling)

- A. Describe four physiological adaptations of different mammals for surviving extreme heat.
- B. Describe four behavioural adaptations of different mammals for surviving extreme heat.

Response/Marking Scheme

A. Perspiration is a means of temperature control in humans that cools by evaporation of water from the skin.	1 1
Relaxation of the muscle tone of the skeletal muscles reduces the heat generated by metabolism.	2
Dilation of the skin capillaries allows more blood to flow to the skin, losing heat by radiation.	2
Panting is a dog's method of losing heat by evaporation of water from the lungs, tongue, and lining of the mouth. (Dogs do not perspire.)	2
Aestivation (estivation) is a physiological mechanism in which the body's metabolic rate is reduced, and the animal becomes torpid, as in desert ground squirrels	2
B. Nocturnal mammals are active during the cooler night, and inactive during the heat of the day.	2
Burrowing mammals such as moles and shrews, remain in the cooler earth, instead of the open sun.	2
Browsing animals, like deer, seek the forest shade in the heat of the day, emerging into sunny clearings in early morning and late afternoon.	2
Many humans adapt to the tropics by taking a siesta in the hottest part of the day.	2
Other humans go swimming to cool themselves in water, and allowing evaporation to cool their skin.	2

Possible: 20
Maximum: (8 × 2) 16

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Biological Control
 CURRICULAR EMPHASIS: Solid Foundations
 KEYWORDS: homeotherm

INSTRUMENT CODE: B061KjER.09
 GUIDELINE OBJECTIVE CODE: 61Kj
 INSTRUMENT TYPE: ER
 KLOPPER: A.1, A.2, A.3
 DIFFICULTY LEVEL: M
 TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to describe the mechanism by which homeotherms maintain a normal body temperature in a cold environment.

Item

Describe the mechanism by which homeotherms maintain a normal body temperature in a cold environment.

Response/Marking Scheme

Sensory neurons in the skin	1
detect the lower ambient temperature	1
and send an impulse to the brain	1
which stimulates muscles to contract,	1
or begin to shiver, generating heat.	2
Cooler blood, passing through the hypothalamus	1
is detected initiating several responses:	1
- constriction of arterioles in the skin	1
preventing loss of heat,	1
- stimulating the anterior pituitary to release TSH	2
to increase metabolic rate, generating more heat,	1
- stimulate hairs to stand on end (piloerection)	1
trapping more air, and insulating the body better.	1

Possible: 15

Maximum: 10

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS: thermoregulation

INSTRUMENT CODE: B061KjSA.01
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: SA
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to list some adaptive changes made in terrestrial organisms for thermoregulation.

Item

List six physiological modifications that have evolved in mammals which allow these organisms to maintain a constant body temperature.

Response/Marking Scheme

Accept any six:

- distribution of capillary beds in specific organs
- adjustment of blood flow to different capillary beds
- vasoconstriction and vasodilation mechanisms
- counter current arrangement of blood vessels
- body fat distribution under the skin and around vital organs
- body shape
- body colouring
- body covering - hair, fur
- shivering
- piloerection
- sweat glands

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Thermoregulation
CURRICULAR EMPHASIS: Solid Foundations
KEYWORDS:

INSTRUMENT CODE: B061KjSA.02
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: SA
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to list the mechanisms by which animals can regulate their temperature.

Item

Animals that live in Canada experience extremes in environmental temperatures. In order to survive, some must maintain a uniform body temperature.

List five means by which natural selection has acted to provide means by which thermoregulation can be accomplished.

Response/Marking Scheme

Accept any five:

- | | |
|--|---|
| - addition or removal of body covering | 1 |
| - increase or decrease in metabolic rate | 1 |
| - move to a more amenable temperature | 1 |
| - increase or decrease of body fat | 1 |
| - increase or decrease muscle action, e.g., shivering | 1 |
| - increase or decrease surface evaporation, e.g., sweating or panting. | 1 |

Possible: 6

Maximum: 5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Thermoregulation
CURRICULAR EMPHASIS: Nature of Science
KEYWORDS: hypothalamus

INSTRUMENT CODE: B061KjSA.03
GUIDELINE OBJECTIVE CODE: 61Kj
INSTRUMENT TYPE: SA
KLOPPER: A.1, A.3, A.4
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Students will be expected to, using the body's reaction to a stimulus such as physical exertion, describe how the nervous and endocrine systems interact to compensate for temporary fluctuations in the body's internal environment.

Item Focus

The student should be able to hypothesize the outcome of an experiment on thermoregulation and discuss the results.

Item

In an hypothetical experiment, human subjects were placed in a room, the temperature of which was higher than body temperature (37°C). At the same time, blood, cooler than 37°C, was infused into the subjects.

- A. Hypothesize the effect of this experiment on the subjects.
- B. Explain your hypothesized results.

Response/Marking Scheme

- A. The subjects would begin to shiver and exhibit reactions to the cold such as hair elevation, and slowed metabolism, even though their surroundings were warmer than normal. 3
- B. The explanation for these results is that even though the environmental temperature was higher than the normal external environment, the controlling element in temperature regulation is the hypothalamus, located internally, at the base of the brain. Since the infused blood was cooler than normal, the response of the hypothalamus was to react as if the individuals were in a cold environment. 3

Possible: 6

Maximum: 6

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Solid Foundations

INSTRUMENT CODE: B061KkMC.01
GUIDELINE OBJECTIVE CODE: 61Kk
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

KEYWORDS: diabetes

Guideline Objective

Students will be expected to describe the cause, effects, and treatment of one or more of the following: diabetes mellitus, diabetes insipidus, hyper- and hypothyroidism, goitre, Addison's disease.

Item Focus

The student should be able to identify a possible cause of glucose in the urine.

Item

The presence of glucose in the urine may suggest

- ☐ A. a normal function of the kidney.
- ☐ B. a low level of anti-diuretic hormone (ADH).
- ☐ C. a low level of glucose in the blood.
- ☐ D. an hormonal deficiency.
- ☐ E. an adequate reabsorption of glucose by the collecting tubules.

Response/Marking Scheme

Correct response: D

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Endocrine System
CURRICULAR EMPHASIS: Practical Application

INSTRUMENT CODE: B061KkMC.02
GUIDELINE OBJECTIVE CODE: 61Kk
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.3, A.5
DIFFICULTY LEVEL: L
TIME ALLOCATION:

KEYWORDS: thyroid

Guideline Objective

Students will be expected to describe the cause, effects, and treatment of one or more of the following: diabetes mellitus, diabetes insipidus, hyper- and hypothyroidism, goitre, Addison's disease.

Item Focus

The student should be able to identify a disorder that results from a malfunction of a homeostatic control system involving an endocrine gland.

Item

A person who has experienced a considerable loss of mass, has protruding eyes, has a low blood calcium level, is easily agitated, and always feels cold is likely suffering from

- ☐ A. diabetes mellitus.
- ☐ B. diabetes insipidus.
- ☐ C. a hyperactive thyroid.
- ☐ D. a hyperactive parathyroid.
- ☐ E. an adrenal tumor.

Response/Marking Scheme

Correct response: C

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Practical Application

INSTRUMENT CODE: B061KkER.01

GUIDELINE OBJECTIVE CODE: 61Kk

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3, F.1, H.6

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: diabetes

Guideline Objective

Students will be expected to describe the cause, effects, and treatment of one or more of the following: diabetes mellitus, diabetes insipidus, hyper- and hypothyroidism, goitre, Addison's disease.

Item Focus

The student should be able to explain why the glycosylation test would be more useful in monitoring insulin therapy than the glucose concentration of blood or urine.

Item

A medical doctor, monitoring a diabetic patient's progress in controlling the condition through insulin therapy, may have a laboratory measure the extent to which the patient's red blood cells have become glycosylated (bound to glucose).

Explain why the glycosylation test would be more useful to the doctor than a measurement of the concentration of glucose in the blood or urine.

Response/Marking Scheme

An increased glycosylation of the red blood cells likely is	1
the result of inadequate insulin levels, resulting in an	1
elevated concentration of blood glucose.	1
Since red blood cells have a life span of about 120 d	1
the test monitors the effects of 4 months of therapy.	1
The other tests only indicate the success of therapy on the day of the test.	1

Possible: 6

Maximum: 4

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Hormones

CURRICULAR EMPHASIS: Practical Application

INSTRUMENT CODE: B061KkSA.01

GUIDELINE OBJECTIVE CODE: 61Kk

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3

DIFFICULTY LEVEL: L

TIME ALLOCATION:

KEYWORDS: endocrine disorders

Guideline Objective

Students will be expected to describe the cause, effects, and treatment of one or more of the following: diabetes mellitus, diabetes insipidus, hyper- and hypothyroidism, goitre, Addison's disease.

Item Focus

Same as above.

Item

Complete the following table to indicate the endocrine gland responsible for each of the diseases shown, the cause of the disease, and one effect or symptom of the disease.

DISEASE	GLAND	CAUSE	EFFECT OR SYMPTOM
diabetes mellitus			
hyperthyroidism			
hypothyroidism			
goitre			
Addison's disease			

Response/Marking Scheme

DISEASE	GLAND	CAUSE	EFFECT OR SYMPTOM
diabetes mellitus	pancreas	insufficient insulin	elevated levels of blood glucose
hyperthyroidism	thyroid	excess secretion	increased rate of metabolism, rapid heart, weight loss bulging eyes
hypothyroidism	thyroid	insufficient secretion	low metabolic rate, lethargy, overweight
goitre	thyroid	lack of iodine to make thyroxine	enlarged thyroid swollen neck
Addison's disease	adrenal cortex	insufficient secretion of glucocorticoids	loss of appetite fatigue, low metabolic rate, depression, death

Maximum: $5 \times 3 = 15$

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Practical Application

INSTRUMENT CODE: B061KkSA.02

GUIDELINE OBJECTIVE CODE: 61Kk

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, F.1, H.6

DIFFICULTY LEVEL: L

TIME ALLOCATION:

KEYWORDS: diabetes glucose tolerance

Guideline Objective

Students will be expected to describe the cause, effects, and treatment of one or more of the following: diabetes mellitus, diabetes insipidus, hyper- and hypothyroidism, goitre, Addison's disease.

Item Focus

The student should be able to explain why the glucose tolerance test should indicate whether or not a person has diabetes.

Item

The glucose tolerance test is often used to determine whether or not a person has diabetes. In this test, the person fasts for 12 h, and then is given a standard amount of glucose to drink. For several hours, the concentration of glucose in the person's blood is monitored.

Explain the relationship between the glucose tolerance test and the homeostatic control of glucose.

Response/Marking Scheme

In a healthy person, glucose entering the blood from the digestive tract should shortly be transported into the liver cells	1
and stored as glycogen.	1
Thus the concentration of glucose in the blood should decline rapidly.	1
Diabetes results from an insufficiency of insulin	1
secreted by the Islets of Langerhans in the pancreas.	1
In the absence of sufficient insulin, the uptake of glucose and its conversion into glycogen are both impaired.	2
Therefore, if the concentration of glucose in the blood remains elevated for an unusually long period, there is reason to suspect diabetes.	1

Possible: 8

Maximum: 5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Nature of Science

KEYWORDS: Selye stress Canadian scientists

INSTRUMENT CODE: B061K1MC.01

GUIDELINE OBJECTIVE CODE: 61K1

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the work findings of individuals such as Banting, Best and Selye.

Item Focus

The student should be able to identify the hormones implicated by Selye in the “General Adaptation Syndrome”.

Item

Selye implicated four of the following hormones or groups in his “General Adaptation Syndrome”. Which one was NOT implicated?

- ☐ A. glucocorticoids
- ☐ B. mineral corticoids
- ☐ C. STH (somatotropin, growth hormone)
- ☐ D. ACTH (adrenocorticotrophic hormone)
- ☐ E. insulin

Response/Marking Scheme

Correct response: E

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Nature of Science

KEYWORDS: Selye stress Canadian scientists

INSTRUMENT CODE: B061K1MC.02

GUIDELINE OBJECTIVE CODE: 61K1

INSTRUMENT TYPE: MC

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the work findings of individuals such as Banting, Best and Selye.

Item Focus

The student should be able to identify the endocrine tissue that is central to the “General Adaptation Syndrome”.

Item

Although many endocrine tissues are involved in producing the “General Adaptation Syndrome” identified by Selye, the major and central role is played by the

- ☐ A. adrenal cortex.
- ☐ B. adrenal medulla.
- ☐ C. thyroid.
- ☐ D. pancreas.
- ☐ E. gonads (testis or ovary).

Response/Marking Scheme

Correct response: A

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Canadian Scientists

CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B061K1ER.01

GUIDELINE OBJECTIVE CODE: 61K1

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.2, A.3, A.8, D.5, D.6, I.3

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: insulin Banting and Best

Guideline Objective

Students will be expected to briefly describe the work findings of individuals such as Banting, Best and Selye.

Item Focus

Same as above.

Item

Give a brief account of the work of Banting and Best in their discovery of insulin. Your answer should deal specifically with the following questions:

- A. What was Banting's hypothesis?
- B. How were the experiments designed to test the hypothesis?
- C. What evidence did Banting and Best observe?
- D. What conclusion followed from the evidence?
- E. Why were Banting and Best successful where many other experimenters failed?

Response/Marking Scheme

- | | |
|--|---|
| A. Hypothesis: The pancreas must produce a hormone | 2 |
| that controls the level of blood glucose. | 2 |
| B. Experimental Design: By tying off the pancreatic duct | 2 |
| of dogs, and waiting for the digestive cells of the | 2 |
| pancreas to degenerate, they made an | 1 |
| extract of the Islets of Langerhans. | 2 |
| They administered doses of the extract to dogs that | 1 |
| had been made diabetic by removal of their pancreas. | 2 |
| Blood glucose levels were measured before and after the injections. | 2 |
| C. Observations: For each of about 70 injections, they observed a decline | |
| in the level of blood glucose and glucose in the urine. | 2 |
| D. Conclusion: There is a hormone, insulin, produced by cells of the Islets | |
| of Langerhans, which reduces the level of blood glucose. | 2 |
| E. Because Dr. J.B. Collip was successful in purifying the extract they were | |
| able to remove the influence of the proteolytic enzymes, to get a better | |
| extract of the islets of Langerhans, reducing side effects. | 2 |

Possible: 22

Maximum: 16

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Endocrine System

CURRICULAR EMPHASIS: Nature of Science

KEYWORDS: Selye Canadian scientists stress

INSTRUMENT CODE: B061K1SA.01

GUIDELINE OBJECTIVE CODE: 61K1

INSTRUMENT TYPE: SA

KLOPPER: A.1, A.2, A.3, A.9

DIFFICULTY LEVEL: L

TIME ALLOCATION:

Guideline Objective

Students will be expected to briefly describe the work findings of individuals such as Banting, Best and Selye.

Item Focus

The student should be able to name three anatomical structures affected by stress, as reported by Selye, and describe how they change.

Item

Hans Selye reported a “triad” of anatomical changes found in animals subjected to stress. Name the three anatomical structures affected, and describe how they change in appearance (as seen in a dissection) as a result of stress.

Response/Marking Scheme

Adrenal glands were enlarged.	2
Thymus/lymph nodes were shrunken.	2
Stomach was ulcerated.	2

Possible: 6

Maximum: 6

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B062c-LA.01
GUIDELINE OBJECTIVE CODE: 62c
INSTRUMENT TYPE: LA
KLOPPER: A.1, A.2, A.3, A.4, A.5, D.3, D.6.
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: thermoregulation sweating hypothalamus

Guideline Objective

Students will the opportunity to perform investigations to demonstrate the maintenance of a stable internal environment in the body.

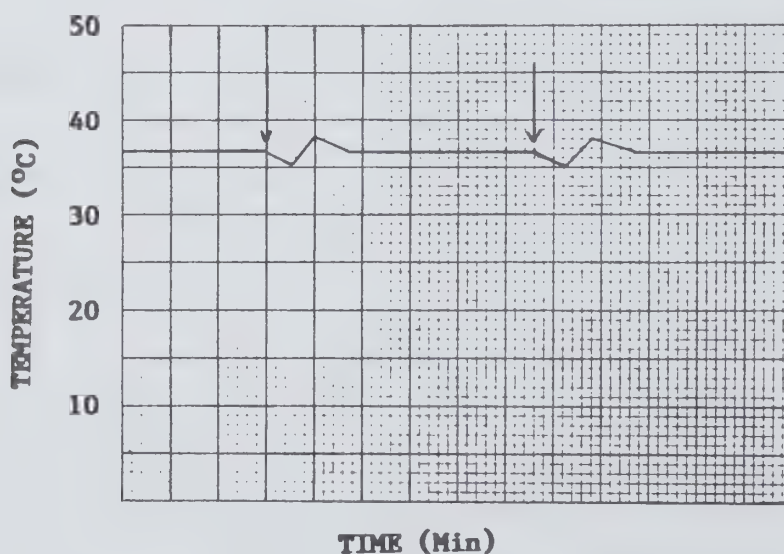
Item Focus

The student should be able to interpret the data obtained in an experiment involving control of body temperature.

Item

Graph 6(2).1 illustrates the results of an experiment in which a man rested in a temperature-controlled chamber which was kept at 45°C. At the times shown he ate a quantity of ice. His internal body temperature was taken at his eardrum.

Analyze the graph and explain the reasons for the observed results.



Response/Marking Scheme

Initially the curve indicates a constant body temperature,	1
even though the room temperature is considerably higher.	1
This illustrates the effects of sweating	1
and that of a homeostatic mechanism.	1
When the ice was ingested, the internal temperature cooled by a few degrees.	1
This lowering of the blood temperature	1
stimulated thermoregulation by the the hypothalamus.	1
Under the influence of the hypothalamus	1
sweating was reduced,	1
thereby reducing heat loss.	1
There followed an increase in the internal body temperatures.	1
This heating of the blood temperature	1
stimulates thermoregulation by the hypothalamus.	1
The hypothalamus reacts,	1
Sweating is adjusted so as	1
to restabilize the internal body temperature to its normal temperature.	1

Possible: 16

Maximum: 12

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Effects of Chemicals
CURRICULAR EMPHASIS: Nature of Science

INSTRUMENT CODE: B062e-LE.01
GUIDELINE OBJECTIVE CODE: 62e
INSTRUMENT TYPE: LE
KLOPPER: A.1, A.2, A.3, A.7, B.1, B.2, D.1,
D.6, G.1, G.2
DIFFICULTY LEVEL:
TIME ALLOCATION:

KEYWORDS: rate of heart beat

Guideline Objective

Students are to perform experiments with invertebrates to examine the internal effects of such external factors as heat and chemicals.

Item Focus

The students should be able to determine the effects of temperature and a hormone on the rate of heart beat of *Daphnia*.

Item

Introduction: The physiological activity of animals is affected by an increase in temperature, and by a stimulating hormone, such as epinephrine (adrenalin).

Materials:

culture of living *Daphnia*
well slide (cavity slide)
coverslip
compound microscope
dropper, glass tube, or pipette
ice cube
1% solution of epinephrine (synthetic adrenalin) Procedure:

1. Using the glass tube or pipette, transfer one of the *Daphnia* in a little water from the live culture to a well slide. The well keeps the water on the slide and prevents the animal from being harmed. Soak up the excess liquid with piece of paper toweling. Carefully lower a cover glass over the well.
2. Put the slide on the stage of the microscope. Bring it to focus under low power. Count the heartbeat rate for a period of 10 s. Repeat the count several time and average the results. (Note: working in pairs, one student should measure the 20 s with a clock, while the other student counts. Work quickly because the heat of the lamp will change the temperature of the specimen.)
3. Remove the slide from the microscope and place it on an ice cube, with the well immediately over the ice. Let stand for 2 min. Observe the change in heart rate, as in step 2.
4. Lift the cover glass. Add 1 small drop of the epinephrine solution and replace the cover glass. Wait 1 min, then count the heartbeat rate again several times as in step 2. Return your specimen to the culture when you have completed your observations.
5. Make a table to present your observations.

Interpretation:

1. What effects do heat and epinephrine have on the rate of heartbeat of the *Daphnia*?
2. How do you know that the heat or the epinephrine caused the effects?
3. In this lab, why is epinephrine considered to be a hormone?

Response/Marking Scheme

Demonstrates skill in handling equipment

5

i.e., Transfers *Daphnia* from culture to slide, uses microscope properly to see *Daphnia*, counts heartbeats successfully.

Typical results:

Average heartbeat at room temperature	26 beats/10 s	1
Average heartbeat after chilling	21 beats/10 s	1
Average heartbeat after epinephrine	38 beats/10 s	1

Answers to the Questions:

1. Chilling slows the rate of beating; epinephrine accelerates it. 2
2. Since the changes in heart rate followed immediately on the environmental change, I conclude that the effects were related to the causes. 2
3. Epinephrine appears to be a hormone, because a small amount of the chemical exerts a control over the functioning of an organ at some distance from its source. 2

Possible: 14

Maximum: 10

Teacher Notes

1. The physiological activity of animals increases with an increase in temperature, and with a stimulating hormone, such as epinephrine (adrenalin). Note the caution on the vial.
2. The exercise is set up with each student determining the rate of heartbeat of a single *Daphnia* under normal conditions, chilled on ice, and with the hormone. Other microscopic crustaceans might do as well: the writer used *Gammarus*, the scud or sideswimmer.
3. If you have enough specimens, you could divide the culture and maintain parts of it at different temperatures, such as 10°C, 20°C, and 30°C. There is a principle of physiology that suggests that an animal's functions double their rate for each 10°C rise in temperature.
4. You may not wish to have students return the specimens to the same culture after they have added the hormone: in that case you should provide a culture for excited specimens.
5. The exercise should take 20-30 min.

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Chemical Influences
CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B063b-ER.01
GUIDELINE OBJECTIVE CODE: 63b
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, F.3, H.3, I.4, I.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: drug abuse psychoactive drugs

Guideline Objective

The student will explain how the discovery and use of psychoactive drugs has had both positive effects (the medical relief of pain) and negative effects (drug abuse and addiction).

Item Focus

The student will explain how the discovery and use of psychoactive drugs has had both positive and negative effects on society.

Item

The products of scientific discoveries can be used in ways which are beneficial to members of society. Unfortunately, there is always the possibility of putting the products of scientific discoveries to uses which are detrimental to members of society. For example, the use of psychoactive drugs under the careful supervision of physicians can be medically beneficial for some people. However, the unsupervised use of some of these substances can lead to drug abuse and addiction.

- A. Develop an argument for the continued research into the use of psychoactive drugs in spite of the potential hazards to members of society.
- B. In your view, should scientists be held responsible for the negative effects of their discoveries? Support your view.

Response/Marking Scheme

- A. The results of scientific research can have both positive and negative outcomes. In the case of psychoactive drugs, the potential benefits for people suffering from a variety of medical disorders, including some forms of mental illness, are worth the risks involved. 1
- However, the root problem is in the issue of who should control the direction of medical research. 1
- If research that holds potential danger is stopped, then in time all research will be stopped. 1
- The issue is one of informing people of the potential dangers which scientists can foresee with a new discovery. 1
- B. One possible view is that scientists involved in a new discovery or line of research should be held responsible for informing the public of potential dangers. 1
- Furthermore, scientists who are involved in discoveries ought to inform and mobilize other scientists to help them inform the public. 1
- Possible: 6
- Maximum: 5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Chemical Influences
CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B063b-ER.02
GUIDELINE OBJECTIVE CODE: 63b Part 1(3.2-
10)(3.3f)
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, H.1, H.2, H.3, I.2
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: psychoactive drugs marijuana

Guideline Objective

The student will apply scientific knowledge to personal decision-making.

Item Focus

The student will demonstrate an understanding that science can inform a societal decision, but other considerations are also applicable.

Item

The use of the drug marijuana is illegal in Canada. However, it appears that the controlled use of the drug relieves nausea in cancer patients who have received certain types of therapy. Since many cancer patients are able to function outside the hospital setting after they have received treatment, it would be beneficial to them if substances such as marijuana could be made available to them in order to alleviate some of the side-effects of their treatment. However, this would make it significantly easier for marijuana to fall into the hands of people not suffering from cancer treatment. Since there has been a continuing public debate over the legalization of marijuana, this consideration further complicates the issue.

- A. What are three of the major considerations that could determine the status of marijuana?
- B. In what way does scientific knowledge speak to the issue of legalization of a drug such as marijuana?

Response/Marking Scheme

- A. Accept any 3 3
1. Physical damage that could result because of the uncontrolled use of marijuana.
 2. Psychological damage caused by the uncontrolled use of the drug.
 3. Addictive potential of the drug.
 4. Public opinion of the harmful effects of the drug.
 5. Profitability of marketing the drug.
- B. Scientific knowledge can inform the public of the risks and potential benefits to cancer patients. 2
- This can be achieved through publication of the results of experimentation to the public in understood forms. 2
- Possible: 7
- Maximum: 5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Societal Implications
CURRICULAR EMPHASIS: Practical Application

INSTRUMENT CODE: B064a-ER.01
GUIDELINE OBJECTIVE CODE: 64a
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, A.7, A.10, F.3,
H.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: open-heart surgery medical applications

Guideline Objective

Students will be expected to relate medical advances in the treatment of nervous and endocrine systems to homeostasis.

Item Focus

The student should be able to relate the steps in open-heart surgery to the homeostasis of the heart.

Item

During open-heart surgery, when surgeons plan to replace a defective heart valve, there are several steps taken to ensure homeostasis. For each of the following steps, account for the procedure in terms of homeostasis.

- A. The patient is attached to a blood oxygenator machine.
- B. Simultaneously with Step A, a transfusion of blood or plasma is administered.
- C. Then a concentrated solution of potassium chloride is infused into the heart. Surgery then begins. When it is completed, the potassium chloride solution is removed from the heart.
- D. An electric shock is then applied to the heart.

Response/Marking Scheme

- | | |
|--|---|
| A. The oxygenator takes over the work of the heart and lungs | 1 |
| allowing the patient's heart to remain stopped during | 1 |
| the time of the operation. | 1 |
| B. The transfusion increases the blood volume to | 1 |
| compensate for the additional volume of the oxygenator machine. | 1 |
| C. The potassium chloride abolishes the concentration gradient across car- | |
| diac muscle fibres. | 1 |
| This eliminates the resting potential, thus | 1 |
| stopping the heart so that the operation can proceed. | 1 |
| D. The shock causes the simultaneous contraction of all the muscle fibres, | 1 |
| permitting the heart to resume its intrinsic, synchronized rhythm. | 1 |

Possible: 10

Maximum: 8

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Treatment of Disease
CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B064a-ER.02R
GUIDELINE OBJECTIVE CODE: 64a Part 1(3.3f)
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.3, I.3, I.4
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: health issues

Guideline Objective

The student will use reliable scientific knowledge and technological information in the process of societal decision-making.

Item Focus

The student will demonstrate a knowledge of how science can inform a societal decision but also be aware of the importance played in the decision-making process by other non-scientific factors.

Item

There are three major parts to our health services in Canada:

- (a) treatment and care of people who are ill,
- (b) prevention of disease,
- (c) care of people with incurable diseases.

Because there is a limited amount of money available for health care, decisions must be made as to how much money is allotted to each of these parts.

In your opinion, rank these three in order of importance. Justify your ranking order. Be sure to include criteria other than scientific ones.

Response/Marking Scheme

There is no "right" answer in the sense that a number of different (defensible) arguments can be made for different orders. The rank ordering depends on the importance that students assign to particular criteria. The issue is one of noting that a variety of considerations impinge on the decisions, and these tend to be context-bound. The students' answers should contain a mixture of scientific and technological reasons, societal reasons, and ethical reasons for their choice.

Teacher Notes

It may be that you would prefer to use this question for class discussion or debate, rather than evaluating opinions.

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Chemical Influences
CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B064a-ER.03
GUIDELINE OBJECTIVE CODE: 64a Part 1(3.3f)
INSTRUMENT TYPE: ER
KLOPPER: I.4, I.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: pharmaceutical companies research

Guideline Objective

The student will use reliable scientific knowledge and technological information in the process of societal decision-making.

Item Focus

The student will use a knowledge of science and the relationship of science to societal decision-making to explore aspects of a practical issue.

Item

Pharmaceutical (drug-manufacturing) companies spend large sums of money advertising their products in an attempt to convince people to try them. Also, these same companies spend large sums of money advertising their products to physicians (medical doctors) trying to convince them to prescribe their medicines.

- A. In your opinion, is the expenditure of this money justified? Support your opinion.
- B. If you worked for a pharmaceutical company, how would you refute the claim that the money spent on advertising might better be spent on further research to develop new and better drugs?

Response/Marking Scheme

A. One argument in favour of spending money on advertising is that advertising informs both the public and physicians as to the availability of specific drugs.	1
Furthermore, the advertising is informative in that it provides information concerning what is available, and the characteristics of the drugs available.	1
Thus in this sense, the advertising is educational. An argument to the contrary is that the amount of money spent is out of proportion to that required to educate people to the availability of the drugs. Perhaps the information in advertisements is primarily designed to persuade people to use a company's products rather than simply to inform.	1
If this is the case, then physicians in particular could be given lists of drugs with their characteristics, and not "sales pitches".	1
B. From the point of view of the drug companies, the money generated in the sale of drugs contributes to the monies available for research.	1
If a drug company cannot convince people to purchase its product, then this money is no longer available.	1
Furthermore, the claims made by drug companies in their advertising are checked by independent agencies for accuracy.	1
Possible:	7
Maximum:	5

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology

LEVEL: OAC

UNIT NUMBER: 06

UNIT NAME: HOMEOSTASIS

TOPIC: Health Issues

CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B064a-ER.04R

GUIDELINE OBJECTIVE CODE: 64a Part 1(3.3f)

INSTRUMENT TYPE: ER

KLOPPER: A.1, A.3, H.2, H.3, I.2, I.4, I.5

DIFFICULTY LEVEL: M

TIME ALLOCATION:

KEYWORDS: issue alcohol smoking

Guideline Objective

The student will use reliable scientific knowledge and technological information in the process of societal decision-making.

Item Focus

The student will show an understanding of the interrelationship between scientific knowledge and decisions dealing with social issues.

Item

Imagine that a scientist has discovered a new chemical which when taken orally in small amounts, would suppress a person's desire to drink alcohol. Furthermore, suppose that this substance is non-toxic, and can be dissolved in water and given to people. In the medical-science field, this would be hailed as a major breakthrough in light of the large number of alcohol-related problems, both physical and mental, that some people face.

- A. Would you be in favour of adding this substance to the drinking water of large cities? Justify your answer.
- B. If a substance were found which removed the desire to smoke cigarettes, would you be in favour of adding this substance to the drinking water of large cities? Justify your answer.

Response/Marking Scheme

- A. The answer that students give to this question turns on their sense of the relative importance of scientific knowledge to deal with a specific problem, and the other ramifications such as personal freedom, the right of choice, and issue of control. The justification of the answer should include a clear statement of the relatively small role that science plays in the decision.
- B. This question is interesting because it deals with the same issues as part A. However, there are two mitigating factors;
- (1) the implication of cigarette smoking as directly tied to cardiovascular problems and lung cancer appears to be more convincing, and
 - (2) the “spirit of the times” is such that it is becoming socially unacceptable to smoke. Here, the role of science may appear to play a more dominant role, but issues other than science probably are more influential in the decision-making process.

Teacher Notes

It may be that would prefer to use this question for class discussion or debate, rather than evaluating opinions.

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: The Endocrine System
CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B064a-ER.05
GUIDELINE OBJECTIVE CODE: 64a Part 1(3.3f)

INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, I.3, I.4
DIFFICULTY LEVEL: M
TIME ALLOCATION:

KEYWORDS: diabetes Banting and Best

Guideline Objective

The student will use reliable scientific knowledge and technological information in the process of societal decision-making.

Item Focus

The student will explain how a scientific and technological advancement may inhibit further advances in the area.

Item

The isolation and purification of insulin by Banting and Best has enabled thousands of diabetics to live productive lives. However, the administration of insulin to diabetics controls the symptoms of the disease, but does not cure the disease. Moreover, there are a number of severe side-effects of diabetes such as circulatory problems which can become serious in later life. Some people have claimed that the isolation and purification of insulin has slowed the pace of research into causes and cures for diabetes. Explain how this view can be supported.

Response/Marking Scheme

In the first years after the isolation and purification of insulin, the alleviation of symptoms suffered by diabetics and the lack of serious side-effects led to a easing of research into cures for diabetes. 1

This was because the life-threatening aspects of the disease appeared to be controlled. 1

Research funds were diverted into the investigation of other diseases that appeared to pose more immediate problems. 1

However, after a period of years, it became apparent that the prolonged use of insulin can have serious side-effects in users. Thus interest has once again been generated in finding ways of "curing" the disease. 1

Possible: 4

Maximum: 4

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Chemical Influences
CURRICULAR EMPHASIS: Science, Technology
and Society

INSTRUMENT CODE: B064b-ER.01
GUIDELINE OBJECTIVE CODE: 64b Part 1(3.2-
10)(3.3f)
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.3, H.1, H.2, H.3, I.3
DIFFICULTY LEVEL: L
TIME ALLOCATION:

KEYWORDS: psychoactive drugs tranquilizers

Guideline Objective

The student will appreciate that the medical use of psychoactive drugs has been beneficial, but drug abuse and addiction are major problems in society.

Item Focus

The student will point out the positive and negative features of psychoactive drugs.

Item

Some drugs, such as tranquilizers, have the ability to reduce worry and unhappiness in people. In other words, such drugs reduce the anxiety level in people. Those who argue for the continued use of such drugs claim that people can perform at work better if they are not burdened with anxiety. Those who oppose the wide-spread use of such drugs claim that these people are not encouraged to deal with problems, but rather isolate themselves from the problems through the use of psychoactive drugs. Furthermore, these drugs are potentially addictive.

Suppose that you are a medical doctor, and you have a number of patients who are not formally diagnosed as anxiety neurotics, but who have stress headaches and stomach pains, which they seem to get when they come under stress.

- A. Would you prescribe a tranquilizer for these people? Why?
- B. State and explain two reasons for adopting the opposite position which you took in part A.

Response/Marking Scheme

- A. If the students answer yes, then they may give reasons such as the people can function better with the drugs, restrict the patients to dosages that reduce the chance of addiction, as long as the drugs are under the control of medical people, the opportunity for abuse is reduced. 3
- B. If the answer is no, then reasons such as the drug treats only symptoms, but does not treat the underlying cause of anxiety. Rather than drugs, psychoanalysis, stress-reduction training, behavioural modification can be helpful in reducing worry and unhappiness. 3

Possible: 6

Maximum: 5

Teacher Notes

It may be that you would prefer to use this question for class discussion, rather than evaluating opinions.

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Biological Control
CURRICULAR EMPHASIS: Communication

INSTRUMENT CODE: B067b-SA.01
GUIDELINE OBJECTIVE CODE: 67b
INSTRUMENT TYPE: SA
KLOPPER: A.1, A.2, A.3, A.10.
DIFFICULTY LEVEL: H
TIME ALLOCATION:

KEYWORDS: ions active transport cell membrane

Guideline Objective

The student will investigate the biochemical mechanisms of hormones in plants and animals.

Item Focus

The student should be able to explain the homeostatic control of the concentration of ions within a cell in terms of a current model of active transport across the cell membrane.

Item

Examine the following table of the concentration of ions (in milliequivalents, the number of ionic charges per L) on both sides of a cell membrane.

ION	EXTRACELLULAR FLUID		INTRACELLULAR FLUID
	blood plasma	lymph	within cells
sodium	142	145	5
potassium	5	4	150

- What mechanism must be at work to maintain the concentrations of ions inside and outside a cell?
- Draw and label a diagram of a current model of the cell membrane, and explain how such a mechanism might work.
- List three functions of potassium in living cells.

Response/Marking Scheme

A. A sodium/potassium pump (or active transport)

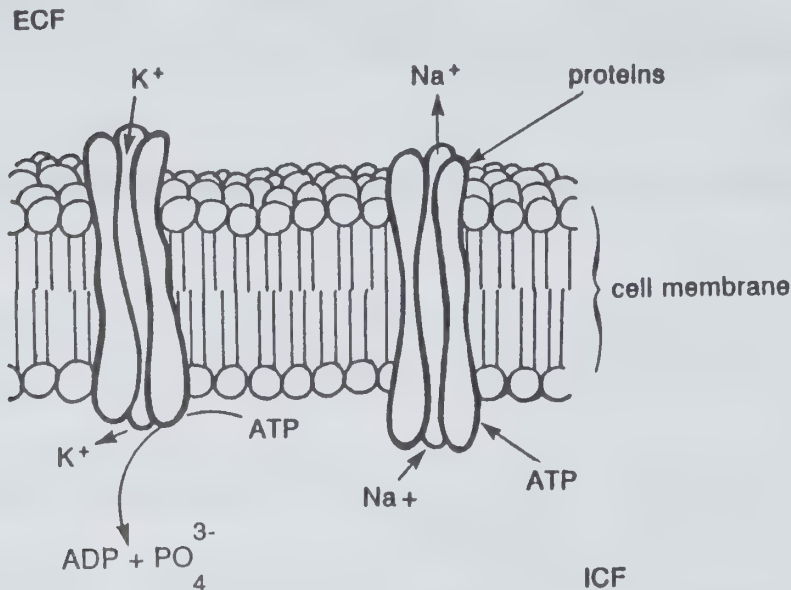
1

B. Diagram

3

Labels

4



Protein molecules, lining the pores of the cell membrane, receive energy from ATP molecules, changing their polarity to attract potassium ions from the extracellular fluid (ECF).

2

1

1

1

Carrier molecules may transport K⁺ ions across the

1

membrane, (or potassium pump) Inside the cell, potassium ions may be exchanged for sodium ions, which may be pumped out by the same mechanism that brought potassium in.

2

C. Potassium ions: (any 3)

help maintain osmotic pressure within cells	1
help form buffers to maintain the pH balance	1
take part in carbohydrate and protein metabolism	1
polarize membranes of nerve cells for transmitting impulses	1
polarize membranes of muscle cells for contraction.	1

Possible: 19

Maximum: 15

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Psychoactive Drugs
CURRICULAR EMPHASIS: Science, Technology
Society
KEYWORDS:

INSTRUMENT CODE: B067e-MC.01
GUIDELINE OBJECTIVE CODE: 67e
INSTRUMENT TYPE: MC
KLOPPER: A.1, A.2, A.6
DIFFICULTY LEVEL: L
TIME ALLOCATION:

Guideline Objective

Some students might explain the following terms and describe the effects of each on the human body: psychoactive drug, stimulant, depressant, hallucinogenic.

Item Focus

The student should be able to explain the term psychoactive drugs.

Item

Psychoactive drugs are ones that

- ☐ A. are used primarily by psychiatrists to induce hypnosis.
- ☐ B. have only a physiological affect on the user.
- ☐ C. primarily affect the functioning of the brain.
- ☐ D. stimulate muscle activity.
- ☐ E. are produced in the brain of a psychotic person.

Response/Marking Scheme

Correct response: C

Teacher Notes

DRAFT

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Psychoactive Drugs
CURRICULAR EMPHASIS: Science, Technology
Society
KEYWORDS: stimulants

INSTRUMENT CODE: B067e-ER.01
GUIDELINE OBJECTIVE CODE: 67e
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, A.3, I.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Some students might explain the following terms and describe the effects of each on the human body: psychoactive drug, stimulant, depressant, hallucinogenic.

Item Focus

The student should be able to list the effects of common psychoactive drugs.

Item

Stimulants form one of the groups of psychoactive drugs, which primarily affect the brain. Caffeine, nicotine, cocaine and the amphetamines are four members of this group of drugs.

List the effects of the drugs mentioned, including harmful side effects.

Response/Marking Scheme

Caffeine: reduces tiredness, increases alertness	1
evidence of mild addictiveness	1
some evidence of involvement in chromosome damage	1
diuretic	1
Nicotine: transient effect as stimulant, followed by depression	1
strong evidence of addictiveness	1
Cocaine: powerful stimulant	
stimulates mental activity, quickness, reflexes	1
nerve cells fire repeatedly (brain like an overloaded switch-board)	1
increases stamina, reduces fatigue	1
gives feeling of confidence and power	1
induces euphoria in some users	1
short lived effects (approx. 1 hr) followed by depression and lethargy	1
repeated use leads to paranoia, psychoses and hallucinations	1
overdose leads to death by heart attack or respiratory failure	1
if 'sniffed', mucus lining of nose deteriorates and snorter is more susceptible to infection and disease	1
Amphetamines: (benzedrine, methedrine)	
induce excitability, restlessness, insomnia, tremors	1
dilates pupils, increases heart rate and blood pressure	1
hallucinations and psychoses	1
if methedrine ('speed') injected into veins induces euphoric rush-extremely dangerous, toxic frequently lethal	1
under medical supervision, have been prescribed for weight loss	1
used to calm hyperactive children	1
treatment for mild form of depression	1

Possible: 22

Maximum: 12

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Psychoactive Drugs
CURRICULAR EMPHASIS: Science, Technology
Society
KEYWORDS: depressants

INSTRUMENT CODE: B067e-ER.02
GUIDELINE OBJECTIVE CODE: 67e
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, I.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Some students might explain the following terms and describe the effects of each on the human body: psychoactive drug, depressant, hallucinogenic.

Item Focus

The student should be able to list the effects of common psychoactive drugs.

Item

‘Depressants’ form one of the groups of psychoactive drugs which primarily affect the mind. Barbituates, alcohol, tranquilizers (valium, librium) phenylcyclidine (PCP angel dust) and the opiates, morphine, heroin and codeine are all members of this group of drugs.

Describe the effects of the drugs mentioned, including any harmful side effects.

Response/Marking Scheme

Barbituates: induce mild sedation, deep sleep or death, dependent on amount taken	1
addictive and tolerance forming, side effects include hangover, drowsiness, dizziness, headache	
Alcohol: loss of muscle control	1
excessive amounts very toxic	1
harmful effect on liver and central nervous system	1
both barbituates and alcohol addictive and tolerance forming	1
side effects of barbituates and alcohol include hangover, drowsiness, dizziness, headache	1
withdrawal symptoms severe — convulsions, delirium, can lead to death	1
Tranquilizers: (and sleeping pills)	
antianxiety drugs, calm nervous tension	1
sleep inducers, muscle relaxants	1
addictive	1
Phencyclidine: (PCP)	
induces hallucinations, fat soluble, stored in fatty tissue, released when fat used, leading to flashbacks by users	1
extremely dangerous when used by humans, used as animal tranquilizer	1
Morphine: relieves severe pain, strongly addictive,	2
lethargy, drowsiness, confusion, euphoria, chronic constipation, depression of respiratory system	2
Heroin: physiological effects similar to morphine more rapid, stronger, longer euphoria,	1
rapid addiction, harder to cure	1
Codeine: similar to morphine in physiological effects less potent, less addictive	1
overdose leads to death	1
Possible:	20
Maximum:	15

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Psychoactive Drugs
CURRICULAR EMPHASIS: Science, Technology
Society
KEYWORDS: hallucinogenic

INSTRUMENT CODE: B067e-ER.03
GUIDELINE OBJECTIVE CODE: 67e
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, I.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Some students might explain the following terms and describe the effects of each on the human body: psychoactive drug, stimulant, depressant, hallucinogenic.

Item Focus

The student should be able to list the effects of common psychoactive drugs.

Item

'Hallucinogenics' form one of the groups of psychoactive drugs, which primarily affect the mind. LSD (lysergic acid diethylamide), mescaline and marijuana are three members of this group of drugs.

Describe the effects of these drugs, including any harmful side effects.

Response/Marking Scheme

LSD and mescaline: heighten sensory perception, alter perception qualitatively	1
extremely potent	1
induce hallucinations, psychoses, colourful visions	1
can cause visual disturbances and schizophrenic behaviour	1
may cause chromosomal damage, especially to germ cells.	1
Marijuana: increases pulse rate, distorts sense of time	1
impairs some complex motor functions (e.g. driving)	1
euphoric sense of light headedness, floating sensation	1
feelings of anxiety	1
sometimes impressions of brilliance, hallucinations	1
heightens enjoyment of food	1
remains in blood stream for several days	1
some evidence that it causes brain damage and perhaps psy-	
choses	1
may cause men's breasts to develop	1
medical use — reduces pressure in eyes of glaucoma sufferers	1
counters nausea caused by chemotherapy cancer treatment	1
some evidence for chromosomal breaks	1
diuretic	

Possible: 17

Maximum: 10

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
LEVEL: OAC
UNIT NUMBER: 06
UNIT NAME: HOMEOSTASIS
TOPIC: Psychoactive Drugs
CURRICULAR EMPHASIS: Science, Technology
Society
KEYWORDS: addiction tolerance

INSTRUMENT CODE: B067e-ER.04
GUIDELINE OBJECTIVE CODE: 67e
INSTRUMENT TYPE: ER
KLOPPER: A.1, A.2, I.5
DIFFICULTY LEVEL: M
TIME ALLOCATION:

Guideline Objective

Some students might explain the following terms and describe the effects of each on the human body: psychoactive drug, stimulant, depressant, hallucinogenic.

Item Focus

The student should be able to explain the terms addiction and tolerance with respect to the use of psychoactive drugs.

Item

Apart from the direct effects and harmful side effects caused by many psychoactive drugs, addiction and tolerance are additional dangers.

Explain the meanings of these terms and discuss three further sources of danger in the general use of psychoactive drugs.

Response/Marking Scheme

Addiction:

- | | |
|--|---|
| The body develops a homeostatic accommodation to | 1 |
| the drug, herefore developing a physical dependence | 1 |
| which leads to withdrawal symptoms if the drug is not taken. | 1 |
| Withdrawal symptoms can, in some cases, lead to death. | 1 |

Tolerance:

- | | |
|---|---|
| A user requires larger and larger doses of the drug to obtain a similar effect. | 1 |
|---|---|

Three further sources of danger in the general use of psychoactive drugs:

- | | |
|---|---|
| 1. The drugs affect different people in different ways, no 'standard' effect for a particular dose. | 1 |
| 2. The strength or purity of drugs bought illegally may vary considerably. | 1 |
| 3. The most serious danger is the synergistic effect of drugs — the enhancement of the effect of one drug by another. | 1 |
| Most often alcohol and another drug, many deaths caused by this effect. | 1 |
| Extremely dangerous to take any two drugs together without medical advice. | 1 |

Possible: 10

Maximum: 7

Teacher Notes

DISCIPLINE/SUBJECT: Science/Biology
 LEVEL: OAC
 UNIT NUMBER: 06
 UNIT NAME: HOMEOSTASIS
 TOPIC: Psychoactive Drugs
 CURRICULAR EMPHASIS: Science, Technology
 Society

INSTRUMENT CODE: B067e-SA.01
 GUIDELINE OBJECTIVE CODE: 67e-
 INSTRUMENT TYPE: SA
 KLOPPER: A.1, A.2, A.6, I.5
 DIFFICULTY LEVEL: L
 TIME ALLOCATION:

KEYWORDS: stimulant depressant hallucinogenic

Guideline Objective

Some students might explain the following terms and describe the effects of each on the human body: psychoactive drugs, stimulant, depressant, hallucinogenic.

Item Focus

Same as above.

Item

- A. Name three groups of psychoactive drugs.
- B. Give a general summary of the effects of each of the groups.

Response/Marking Scheme

A. Stimulants, depressants, hallucinogenics	3
B. <u>Stimulants:</u>	
increase metabolic rate and alertness, speed up mental processes	2
generally elevate the mood.	1
<u>Depressants:</u>	
reduce level of consciousness,	1
reduce intensity of reaction to environmental stimuli	1
dull emotional responses.	1
<u>Hallucinogenics</u>	
induce hallucinations, psychoses, colourful visions	3
qualitatively alter perception.	1

Possible: 13

Maximum: 10

Teacher Notes

1. <i>Psychomotor Development</i>	1. <i>Psychomotor Development</i>
2. <i>Psychomotor Development</i>	2. <i>Psychomotor Development</i>
3. <i>Psychomotor Development</i>	3. <i>Psychomotor Development</i>
4. <i>Psychomotor Development</i>	4. <i>Psychomotor Development</i>
5. <i>Psychomotor Development</i>	5. <i>Psychomotor Development</i>
6. <i>Psychomotor Development</i>	6. <i>Psychomotor Development</i>
7. <i>Psychomotor Development</i>	7. <i>Psychomotor Development</i>
8. <i>Psychomotor Development</i>	8. <i>Psychomotor Development</i>
9. <i>Psychomotor Development</i>	9. <i>Psychomotor Development</i>
10. <i>Psychomotor Development</i>	10. <i>Psychomotor Development</i>

Guideline Objectives: to provide a basis for the development of a curriculum for the study of the human body, its functions, and its response to the environment. The objectives are to provide a basis for the development of a curriculum for the study of the human body, its functions, and its response to the environment.

1. *Psychomotor Development*
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